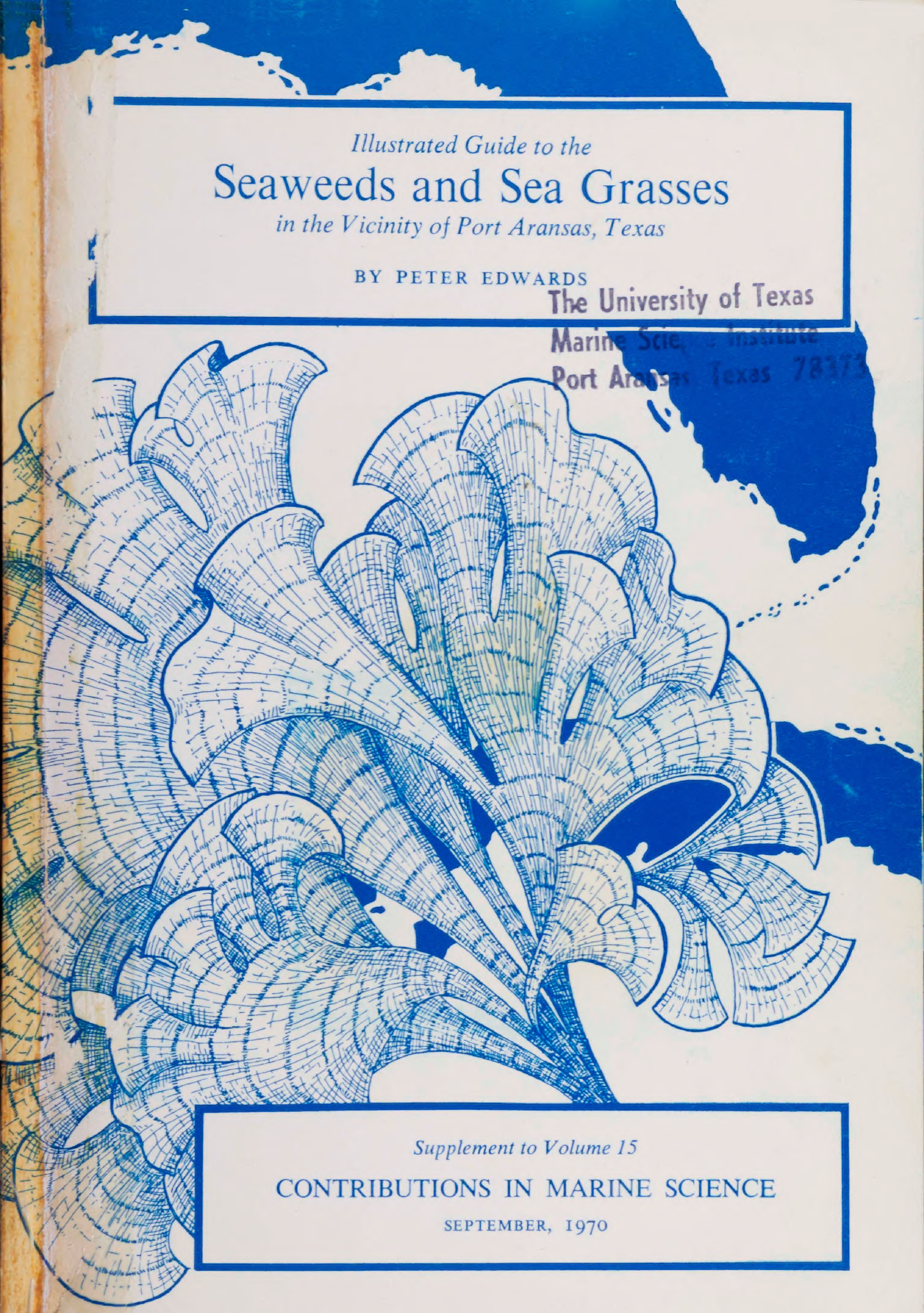
*Illustrated Guide to the*

# Seaweeds and Sea Grasses

*in the Vicinity of Port Aransas, Texas*

BY PETER EDWARDS

The University of Texas
Marine Scie[illegible] Institute
Port Aransas Texas 78373



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# Seaweeds and Sea Grasses

*in the Vicinity of Port Aransas, Texas*

BY PETER EDWARDS

EDITOR: B. J. COPELAND

TECHNICAL EDITOR: MRS. LOREE HAMRICK

## EDITOR'S NOTE

We are offering this treatise on the marine algae and sea grasses, "Illustrated Guide to the Seaweeds and Sea Grasses in the Vicinity of Port Aransas, Texas," by Peter Edwards as a supplement to volume 15 of our Contributions in Marine Science. With the initiation of supplements to our journal, we hope to encourage preparation of similar works regarding other groups of organisms in the northwestern Gulf of Mexico and its coast.

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# ILLUSTRATED GUIDE TO THE SEAWEEDS[1] AND SEA GRASSES IN THE VICINITY OF PORT ARANSAS, TEXAS

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## INTRODUCTION

The guide is based on observations carried out in the vicinity of the University of Texas Marine Science Institute at Port Aransas between June, 1967 and July, 1969.

The present work makes no pretense of being a taxonomic contribution, but it is rather a means of enabling one with little experience in marine plants to arrive at identifications of the local flora. Descriptions have been kept to a minimum and technical terms avoided in so far as possible. The meaning of those which were deemed necessary may be obtained from the Glossary. One or more photographs of each plant have been included in the belief that a good illustration is generally worth far more than a lengthy description. For those who desire to consult more complete specific descriptions, these may be found in more technical works, such as Taylor (1957, 1960) and Earle (1969). The descriptions and measurements given in the text are based largely on specimens collected during the study and may deviate from those previously published.

The description of each species is accompanied by brief notes on its distribution in the study area. The seasonal occurrence of each taxon is indicated and an

[1] Chlorophycophyta, Phaeophycophyta and Rhodophycophyta.

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attempt has been made to assess arbitrarily the frequency of occurrence of each species. Rare species were observed on one or two occasions, frequent species on several occasions and common species were found on many occasions (often in abundance) during the study. The terminology of Lewis (1961) has been adopted to describe the vertical position of the algae on the shore. The sublittoral zone is largely submerged and is only rarely exposed to the air; the eulittoral zone is alternately submerged and exposed to the air because of the tide; and the littoral fringe is largely exposed to the air, but is kept moist by wash, splash, and spray. A detailed treatment of the benthic marine algal ecology of the area is in preparation.

A key to the genera found within the area is provided, and in addition, a key to the species within each genus is given in the section on the systematic account of the species. The generic and specific names used by Taylor (1957, 1960) are given in parentheses in the systematic account if they differ from those used in the guide.

Sections are also provided on the structure and reproduction of marine algae and on their collection, preservation and laboratory culture.

## LOCATION AND DESCRIPTION OF THE AREA

The area covered by the guide lies to the northeast of Corpus Christi, Texas in the northwest corner of the Gulf of Mexico (Fig. 1).

The coast of Texas consists of a barrier island which fronts a coastal lagoon; the latter has been broken up into a series of relatively shallow bays in the vicinity of Port Aransas.

The outer shoreline of the barrier island comprises a beach of fine, unconsolidated sand, from which benthic marine algae are largely absent due to the absence of solid substrata for their attachment. The bays behind the barrier island are connected to the open sea by a tidal inlet at Port Aransas, which has been stabilized by the construction of a pair of stone jetties. The jetties are 1 to 1.5 miles long and extend out into the Gulf. They are roughly triangular in cross-section and are composed of large granite quarry blocks each weighing several tons which have been capped with concrete for a footpath. The jetties provide an area of rocky coast on a shore otherwise inhospitable for algal growth and they are densely covered with algae.

Aransas and Redfish Bays, situated behind the barrier island, have mainly unconsolidated sandy and muddy bottoms, which are unsuitable for algal growth. However, the shallow regions of the bays are often colonized by extensive beds of sea grasses which stabilize the bottom sediments so that algae may become established. Substrata for algae in the bays are provided by the sea grasses themselves, by shells and by man-made constructions such as sea walls, pier posts and bridge supports.

The habitats present in the study area are illustrated in Figs. 2–9.

## NATURE AND AFFINITIES OF THE BENTHIC MARINE ALGAL FLORA

The marine environment is dominated by a heterogeneous collection of lower

plant life collectively known as algae or seaweeds. Seed plants, which dominate the terrestrial environment, are poorly represented in the sea by the sea grasses.

The marine algal flora of Texas is among the least known in the United States; for most areas of the state's coast, there is little or no information. The flora is rather limited in extent, possibly because of the predominantly sandy and muddy shore and the great fluctuations in temperature and salinity.

The flora is basically one of tropical Caribbean affinity, the maximum growth of most species occurring during the warmer months of the year. In winter and early spring, species of cool temperate North Atlantic affinity predominate and the tropical species persist in a state of reduced stature or apparently disappear (Conover 1964).

Eight-eight species representing 52 genera were collected during the study. The red algae constitute the largest part of the flora in terms of abundance and number of species and thus reflect the tropical nature of the flora (52 species or 60.2%). Green algae such as *Enteromorpha, Ulva* and *Cladophora* occur in such abundance as to overshadow the fact of the group's relatively small diversity in the area (21 species or 23.9%). Brown algae such as fucoids[1] and kelps, which dominate the shore in temperate and polar waters, are completely absent from the area and the group as a whole constitutes only a small portion of the flora (14 species or 15.9%). The vertical and seasonal distributions of the local algae are illustrated in Figs. 10–18.

## COLLECTION AND PRESERVATION OF MARINE ALGAE

To obtain a thorough understanding of the nature of the flora, it is necessary to collect during both the summer and winter months in order to sample the two elements of the flora. The tropical element is best developed in June and July and the temperate element in February and March, but a variety of algae may usually be obtained during any month of the year.

Collections may be made in the relatively protected bays at any time. However, since the jetties at Port Aransas extend out into the open sea, collecting depends very much on the weather, particularly the wind. The prevailing southeasterly winds often make collecting dangerous, but calm periods frequently occur when collections may be made along most of the jetty. During the winter, a good collecting period generally occurs immediately following a "norther," when one or more days of calm weather occur prior to the onset of the southeasterly winds. The tidal amplitude is small (the maximum range in 1967 was 3.3 feet), but collecting is facilitated by a low tide when the lower levels of algae are exposed to the air.

The water in the area is generally turbid with accompanying low visibility, but clear water with good underwater visibility occasionally occurs; algae may then be collected by means of a face mask and snorkel, providing that the water is calm.

Warm water occurs for the greater part of the year, but full-length trousers should be worn to protect against cuts and scratches from oysters and barnacles. Tennis shoes with deeply corrugated soles greatly aid movement on the jetty,

[1] Except *Sargassum.*

which is often slippery due to the growth of algae. In winter, when the water is rather cool, hip boots or waders will keep the collector dry.

The algae are best placed as they are collected in small plastic bags with a little seawater to keep them moist; the bags may be carried in a plastic bucket. Glass containers are best avoided. Small specimens or others of special interest should be kept separate. Detailed field notes concerning each specimen should be made *at the time of collection*, including at least the habitat, locality and date of collection.

The algae should be sorted as quickly as possible upon arrival back at the laboratory to prevent unnecessary deterioration. They may be placed in shallow white enamel pans containing seawater for a preliminary examination. If it is desired to culture certain specimens, a small piece should be placed in fresh seawater or culture medium as soon as possible. The remainder of the collection may be preserved or pressed.

Seawater mixed with commercial 40% formalin to obtain approximately a 3 to 5 % solution, together with a little borax to act as a buffer, comprises a good general-purpose liquid preservative. The bottles containing the fixed material should be kept in the dark to retard loss of color of the algae.

To press a seaweed, float the specimen in a broad shallow tray containing seawater. Insert the paper beneath the plant and spread the alga out in a natural manner, using forceps. Gently raise the sheet out of the pan and allow the water to drain off so as to leave the specimen undisturbed. A thin piece of wood or noncorrosive metal placed beneath the sheet often facilitates the drainage of the water off the paper. The specimens should ultimately be mounted on standard $11\frac{1}{2} \times 16\frac{1}{2}$ inch herbarium paper, but the author found plain white, $5 \times 8$ inch library index cards useful for initially mounting most specimens. Place the mounted specimens in a plant press, between sheets of newspaper to dry. The algae should be covered with cheese cloth or unbleached muslin to prevent them from sticking to the newspaper. Corrugated cardboard placed between the sheets of newspaper at intervals allows air to circulate through the press and facilitates drying. The specimens may be dried satisfactorily at room temperature. The newspaper should be changed daily until the specimens are completely dry. Many specimens do not adhere well to paper and will need to be secured to the herbarium sheet with paste after drying. Each sheet should bear a label in the lower right hand corner containing the name of the specimen, the date of collection, the habitat, the locality, the name of the collector and the person who makes the identification of the specimen.

Permanent slides may be made by using Karo corn syrup. The material should initially be fixed in formalin-seawater for about 24 hours and then rinsed with tap water. The specimen may be stained with 1% aqueous aniline blue on a slide. A drop of 1% HCl should be added, left for about 1 minute to fix the stain and then rinsed off with tap water. Karo syrup (50 to 75%, diluted with tap water) containing a few drops of formalin is added to the stained material on the slide followed by a cover slip to complete the preparation, which is self-sealing. The slide should be stored flat for several days until thoroughly dry.

To identify many algae, it is necessary to cut sections of the thallus. Fairly

thin sections may be readily made with a little practice, using a single-edge razor blade. The specimen is held with the index finger on a glass slide and sliced with the blade against the finger nail or another slide for support.

Calcareous algae, particularly the crustose ones, require decalcifying for study. The material (fresh, dried or fixed) may be placed in Pérényi's Solution, which is composed of four parts 10% nitric acid, three parts 70% alcohol, and three parts 0.5% chromic acid. The thin crustose red algae found in the area may be decalcified within a few hours using the above solution. The material may then be rinsed in tap water and sections cut by hand (more detailed information concerning the preservation and preparation of algae may be found in Dawson 1966).

## CULTURING MARINE ALGAE

The relative paucity of information on culturing marine algae is hard to understand, since in the author's experience the majority of specimens readily take to laboratory culture. Very little apparatus and experience are required and a great deal of information about the algae may be obtained by following their growth in the laboratory.

Von Stosch's enriched seawater medium supports the growth of a large number of marine algae in the area. The seawater should be filtered to remove large organic particles and sand and then sterilized by autoclaving. To each liter of seawater, then add the following.

Salts:

| | |
|---|---|
| $NaNO_3$ | 42.50 mg |
| $Na_2HPO_4 \cdot 12\ H_2O$ | 10.75 mg |
| $FeSO_4 \cdot 7H_2O$ | 278.00 μg |
| $MnCl_2 \cdot 4H_2O$ | 19.80 μg |
| $Na_2EDTA \cdot 2H_2O$ | 3.72 mg |

Vitamins:

| | |
|---|---|
| Thiamine HCl | 0.20 mg |
| Biotin | 1.00 μg |
| $B_{12}$ | 1.00 μg |

It is convenient to prepare a stock solution of each salt in distilled water, of such concentration that 1 ml of the stock solution gives the required concentration of each ingredient. The three vitamins may be incorporated in the same stock solution, which should be refrigerated.

Algae which are desired for culture should be transported to the laboratory in vials of sterile seawater or culture medium. Transportation provides a problem only during the summer, when care should be taken to ensure that the algae do not get too hot.

Spores or swarmers, if these are available, constitute the best starting point for a culture, since they are initially free of contamination from other algae.

However, the tips of the thalli of most algae readily grow into large plants, if they are excised and placed in culture.

Algae are best manipulated with dissecting needles under a stereoscopic binocular microscope. Spores, swarmers and tips of thalli may be picked up by means of a micropipette. A piece of thin glass tubing or disposable Pasteur glass pipette, drawn out after heating in a microflame, readily sucks up small objects by capillarity. The pieces of algae may then be blown out into a container of fresh medium.

A species is more easily maintained if it is in unialgal culture. Thus, it is important to select specimens from nature which appear to be relatively free from contamination. A few grains of germanium dioxide added to the medium will inhibit the growth of diatoms, the commonest form of contamination.

As a general rule, an alga grows best in the laboratory in conditions which most closely approximate those under which the specimen was growing in nature. However, most of the algae in the area will grow quite well under ordinary laboratory conditions of temperature and lighting. Members of the cool temperate element in the flora grow better under a lower temperature regime, *i.e.*, 12 to 15 C.

Almost any type of container may be employed for culturing algae, but Petri dishes which provide a large surface area to volume ratio of the medium are especially useful. The medium should be replenished every one to two weeks, depending on the density of algal growth.

## STRUCTURE AND REPRODUCTION OF MARINE ALGAE

The following discussion is based on genera covered by the guide and consequently is restrictive with regard to seaweeds in general.

The *filament* comprises the fundamental unit of organization of seaweeds. The unbranched uniseriate filament consists of a single row of cells which divide in a plane perpendicular to the long axis of the filament, *e.g.*, *Chaetomorpha* and *Erythrotrichia*. An occasional single cell division at right angles to the dominant plane of cell division gives rise to a branched uniseriate filament, *e.g.*, *Entocladia*. Branched, uniseriate filamentous algae are often organized into prostrate and erect portions, *e.g.*, *Cladophora*, *Ectocarpus* and *Polysiphonia*. Branched, uniseriate filaments may coalesce laterally to form discs which adhere to the substratum, *e.g.*, *Ulvella* and *Erythrocladia*.

The elaboration of the uniseriate filament to give more complex thalli proceeds in two directions. Many cell divisions in two planes at right angles produce a sheet-like expanse one cell thick, *e.g.*, *Porphyra*. A cell division in a plane parallel to the surface of expansion results in a distromatic thallus, *e.g.*, *Ulva*. The tubular thallus (plant) of *Enteromorpha* arises from a separation of the two cell layers that comprise the distromatic sheet. Many cell divisions in a plane parallel to the surface of expansion produce a parenchymatous thallus several cells thick, *e.g.*, *Padina*. Cell divisions proceeding freely in three planes at right angles result in parenchymatous thalli many cells thick, *e.g.*, *Sargassum*.

In the second method of elaboration of the uniseriate filament cell division

continues to take place primarily in a plane perpendicular to the long axis of the filament. A ring of initials is cut off at the apex of each cell in certain red algae. The initials divide to form a small-celled cortex which is restricted to bands around the junction of successive cells of the filament in *Ceramium*, but which covers the central cells completely in *Centroceras*. In the Rhodomelaceae, each cell of the filament divides to give a ring of pericentral cells which surround the central filament, *e.g.*, *Polysiphonia* and *Bryocladia*. These algae are said to be *polysiphonous* since the cells of each segment are all of identical length. In genera such as *Laurencia* and *Chondria*, the pericentral cells undergo extensive cortication to produce more massive thalli. Many algae are composed of densely branched filaments, particularly red algae. The main axes of unlimited growth produce lateral branches of limited growth, which are closely compacted to produce massive thalli. The algae are said to be *uniaxial* if the main axis consists of a single row of cells (*e.g.*, *Gelidium* and *Hypnea*) and *multiaxial* if the axis is made up of a number of parallel filaments (*e.g.*, *Cladosiphon*, *Grateloupia* and *Gracilaria*). The outer cells of the branch systems are generally small and pigmented and comprise the *cortex*, whilst the inner cells are usually larger and colorless and are referred to as the *medulla*. Elaborate thalli produced from one or more filaments, as described above, are said to be *pseudoparenchymatous*.

The cell divisions through which the thallus increases in size may be diffuse, intercalary or apical. Cell divisions which take place throughout the thallus are said to be *diffuse*, *e.g.*, *Enteromorpha*, *Ectocarpus* and *Petalonia*. *Intercalary cell divisions* take place in localized regions of the thallus and if they are confined to the bases of terminal hairs, as in *Cladosiphon*, they are referred to as *trichothallic*. *Apical growth*, in which one or more apical cells cut off new cells basally, takes place in *Cladophora* and *Dictyota*. The apical growth of a system of branched filaments is the basic structural characteristic of the floridean red algae, *e.g.*, *Acrochaetium* and *Rhodymenia*.

Certain green algae possess a vegetative thallus in which cross walls are absent. These plants of siphonous habit are often referred to as *coenocytes*, *e.g.*, *Bryopsis* and *Derbesia*.

The algae demonstrate a great diversity of life-histories and reproductive bodies. Three basic types of life-history may be recognized: (1) the alga consists of a single free-living phase and is thus referred to as *haplobiontic*; the plant body is haploid and the diploid condition prevails in the zygote following fusion of the gametes; meiosis takes place on the germination of the zygote, which reinitiates a new generation of haploid plants; and thus an alternation of nuclear phases takes place (*e.g.*, *Ulothrix*): (2) the alga again consists of a single phase and is thus *haplobiontic*, but the plant body is diploid; meiosis occurs in the production of the gametes and the zygote grows into a new diploid generation; and again only an alternation of nuclear phases takes place (*e.g.*, *Acetabularia*): and (3) haploid and diploid morphological phases occur in the life-history and are generally designated as gametophytic and sporophytic phases, respectively; the haploid gametophyte forms gametes, which fuse, and the resultant zygote develops into a diploid sporophyte; meiosis takes place at spore formation by the sporophyte and the haploid spores reinstitute the haploid gametophyte; and thus, an alter-

nation of both morphological and nuclear phases takes place. Plants with an alternation of two free-living morphological phases are designated *diplobiontic*. If the two phases have an identical morphology, they are said to be *isomorphic* (*e.g.*, *Cladophora* and *Padina*); if the phases are dissimilar, they are said to be *heteromorphic*. *Bangia* and *Porphyra* have heteromorphic phases in their life-histories, although the nuclear phases of these two genera are imperfectly known. Many red algae have three sequential phases in the life-history since a carposporophytic phase is intercalated between fertilization and the development of the (tetra-) sporophyte. The diploid zygote is retained on the haploid female gametophyte and develops into a diploid "parasitic" *carposporophyte*. Diploid carpospores formed by the latter phase develop into the diploid *tetrasporophyte*.

Many kinds of reproductive bodies are formed by algae. Most green algae have reproductive organs which are developed from unmodified vegetative cells, *e.g.*, *Chaetomorpha*. In the coenocytic green alga, *Bryopsis*, lateral branches cut off from the main axis by transverse septa function as reproductive organs. The umbrella-shaped cap of *Acetabularia* comprises gametangial rays which form cysts; the latter release the motile gametes.

The majority of brown algae have *unilocular* or *plurilocular* organs or both, *e.g.*, *Ectocarpus* and *Cladosiphon*. The former type of organ is unicellular and the contents divide to give many swarmers. The latter type is multicellular in which each cell produces a single swarmer. Plurilocular organs may be *uniseriate* (*e.g.*, *Streblonema* in part) or *pluriseriate* (*e.g.*, *Giffordia*). In *Dictyota* and *Padina*, the sporophytes bear distinctive unilocular sporangia that produce non-motile "tetraspores." The male gametangia of these two genera are plurilocular organs and are referred to as *antheridia*, but the female gametangia produce a single large non-motile *egg* within an *oogonium*.

Flagellated reproductive bodies are absent from the red algae. Asexual reproduction by *monospores* constitutes the only known method of reproduction for many of the less specialized members of the group, *e.g.*, *Goniotrichum* and *Acrochaetium*. *Bangia* and *Porphyra* have little-differentiated reproductive bodies, in spite of their heteromorphic, diplobiontic life-histories. Large pigmented $\alpha$ spores repeat the larger phase or give rise to the alternate phase, *Conchocelis*, depending on the environment. The function of the small colorless $\beta$ spores is unknown. The majority of the Florideophycidae have an isomorphic, diplobiontic life-history, in which the gametophytic generation consists of separate male and female plants. Male gametophytes produce minute, colorless *spermatia*, which are liberated singly from *spermatangia* or *antheridia*. The spermatangia may be formed superficially on the thallus in patches or sori (*e.g.*, *Hypnea*) or in special spermatangial branches (*e.g.*, *Polysiphonia*). The female sex organ, the *carpogonium*, bears an elongated receptor for the spermatia, the *trichogyne*. The fertilized carpogonium, or zygote, remains *in situ* and develops into a "parasitic" carposporophytic phase on the female gametophyte. The carposporophytic phase forms superficial free masses of carpospores (*e.g.*, *Callithamnion*), is embedded within the female thallus without a definite envelope (*e.g.*, *Grateloupia*) or forms a prominent bulge on the female thallus with an urn-shaped envelope (*pericarp*) which is then called a cystocarp (*e.g.*, *Graci-*

*laria*). The tetrasporangia may be borne superficially over the surface of the thallus, either scattered (*e.g.*, *Gracilaria*) or grouped into sori (*e.g.*, *Gelidium*). The sori may be restricted to lateral branches (*e.g.*, *Chondria*) or produced in superficial cavities or conceptacles (*e.g.*, the coralline algae). The tetraspores may be arranged in the tetrasporangia *zonately* (*e.g.*, *Agardhiella*), *cruciately* (*e.g.*, *Gelidium*) or *tetrahedrally* (*e.g.*, *Polysiphonia*). Good accounts of the morphology and reproduction of seaweeds may be found in the textbooks of Dawson (1966) and Boney (1966).

## SYSTEMATIC LIST OF BENTHIC MARINE ALGAE

### DIVISION CHLOROPHYCOPHYTA

Class CHLOROPHYCEAE

Order ULOTRICHALES

Family Ulotrichaceae

*Ulothrix flacca* (Dillwyn) Thuret

Family Chaetophoraceae

*Entocladia viridis* Reinke
*Ulvella lens* Crouan et Crouan

Order ULVALES

Family Ulvaceae

*Enteromorpha clathrata* (Roth) Greville
*E. flexuosa* (Wulfen ex Roth) J. Agardh
*E. lingulata* J. Agardh
*E. prolifera* (Mueller) J. Agardh
*E. ramulosa* (J. E. Smith) Hooker
*E. salina* Kuetzing
*Ulva fasciata* Delile
*U. lactuca* Linnaeus

Order CLADOPHORALES

Family CLADOPHORACEAE

*Chaetomorpha linum* (Mueller) Kuetzing
*Cladophora albida* (Hudson) Kuetzing
*C. dalmatica* Kuetzing
*C. delicatula* Montagne
*C. ruchingeri* (Agardh) Kuetzing
*C. vagabunda* (Linnaeus) v. d. Hoek

Order CODIALES

Family Derbesiaceae

*Derbesia vaucheriaeformis* (Harvey) J. Agardh

Family Bryopsidaceae

*Bryopsis hypnoides* Lamouroux
*B. plumosa* (Hudson) C. Agardh

Order Dasycladales

Family Dasycladaceae

*Acetabularia crenulata* Lamouroux

## DIVISION PHAEOPHYCOPHYTA

Class PHAEOPHYCEAE

Order Ectocarpales

Family Ectocarpaceae

*Ectocarpus siliculosus* (Dillwyn) Lyngbye
*Giffordia indica* (Sonder) Papenfuss et Chihara
*G. mitchelliae* (Harvey) Hamel
*G. rallsiae* (Vickers) Taylor
*Streblonema oligosporum* Stroemfelt
*Streblonema* sp.

Order Dictyotales

Family Dictyotaceae

*Dictyota dichotoma* (Hudson) Lamouroux
*Padina vickersiae* Hoyt

Order Chordariales

Family Chordariaceae

*Cladosiphon occidentalis* Kylin

Order Dictyosiphonales

Family Striariaceae

*Stictyosiphon subsimplex* Holden

Family Punctariaceae

*Myriotrichia subcorymbosa* (Holden) Blomquist

Order Scytosiphonales

Family Scytosiphonaceae

*Petalonia fascia* (O. F. Mueller) Kuntze

Order Fucales

Family Sargassaceae

*Sargassum fluitans* Boergesen
*S. natans* (Linnaeus) J. Meyen

# DIVISION RHODOPHYCOPHYTA

Class RHODOPHYCEAE

Subclass BANGIOPHYCIDAE

Order GONIOTRICHALES

Family Goniotrichaceae

*Asterocytis ramosa* (Thwaites) Gobi
*Goniotrichum alsidii* (Zanardini) Howe

Order BANGIALES

Family Erythropeltidaceae

*Erythrocladia subintegra* Rosenvinge
*Erythrotrichia carnea* (Dillwyn) J. Agardh

Family Bangiaceae

*Bangia fuscopurpurea* (Dillwyn) Lyngbye
*Porphyra leucosticta* Thuret

Subclass FLORIDEOPHYCIDAE

Order NEMALIALES

Family Acrochaetiaceae

*Acrochaetium crassipes* Boergesen
*A. flexuosum* Vickers
*A. hoytii* Collins
*A. seriatum* Boergesen
*A. virgatulum* (Harvey) J. Agardh

Order GELIDIALES

Family Gelidiaceae

*Gelidium crinale* (Turner) Lamouroux
*Pterocladia bartlettii* Taylor
*P. capillacea* (Gmelin) Bornet et Thuret

Order CRYPTONEMIALES

Family Corallinaceae

*Heteroderma lejolisii* (Rasanoff) Foslie
*Dermatolithon pustulatum* (Lamouroux) Foslie
*Corallina cubensis* (Montagne) Kuetzing
*C. subulata* Ellis et Solander
*Jania capillacea* Harvey

Family Cryptonemiaceae

*Grateloupia filicina* (Wulfen) C. Agardh

Order GIGARTINALES

Family Solieriaceae

*Agardhiella tenera* (J. Agardh) Schmitz

Family Hypneaceae

*Hypnea cornuta* (Lamouroux) J. Agardh
*H. musciformis* (Wulfen) Lamouroux

Family Gracilariaceae

*Gracilaria debilis* (Forsskål) Boergesen
*G. foliifera* (Forsskål) Boergesen
*G. verrucosa* (Hudson) Papenfuss

Order Rhodymeniales

Family Rhodymeniaceae

*Rhodymenia pseudopalmata* (Lamouroux) Silva

Family Champiaceae

*Lomentaria baileyana* (Harvey) Farlow
*Champia parvula* (C. Agardh) Harvey

Order Ceramiales

Family Ceramiaceae

*Callithamnion byssoides* Arnott ex Harvey in Hooker
*Griffithsia tenuis* C. Agardh
*Spermothamnion* sp.
*Ceramium byssoideum* Harvey
*C. fastigiatum* (Roth) Harvey f. *flaccida* H. E. Petersen
*C. strictum* (Kuetzing) Harvey
*Centroceras clavulatum* (C. Agardh) Montagne
*Spyridia aculeata* (Schimper) Kuetzing
*S. filamentosa* (Wulfen) Harvey

Family Rhodomelaceae

*Polysiphonia boldii* Wynne et Edwards
*P. denudata* (Dillwyn) Kuetzing
*P. echinata* Harvey
*P. gorgoniae* Harvey
*P. havanensis* Montagne
*P. subtilissima* Montagne
*P. tepida* Hollenberg
*Bryocladia cuspidata* (J. Agardh) De Toni
*B. thyrsigera* (J. Agardh) Schmitz
*Digenia simplex* (Wulfen) C. Agardh
*Herposiphonia tenella* (C. Agardh) Ambronn
*Chondria cnicophylla* (Melvill) De Toni
*C. dasyphylla* (Woodward) C. Agardh
*C. littoralis* Harvey
*Laurencia poitei* (Lamouroux) Howe

## MARINE FLOWERING PLANTS

## DIVISION ANTHOPHYTA

Class ANGIOSPERMAE

Subclass MONOCOTYLEDONEAE

Order HYDROCHARITALES

Family Hydrocharitaceae

*Halophila engelmannii* Ascherson
*Thalassia testudinum* Koenig et Sims

Order NAJADALES

Family Potamogetonaceae

*Cymodocea filiforme* (Kuetzing) D. S. Correll
*Diplanthera wrightii* (Ascherson) Ascherson
*Ruppia maritima* Linnaeus

### GENERIC KEY

## BENTHIC MARINE ALGAE

1. Thallus calcified ..... 2
1. Thallus not calcified ..... 6
   2. Thallus an elongated stalk with a distal umbrella-shaped cap; green ..... ACETABULARIA p. 23)
   2. Thallus otherwise ..... 3
3. Thallus an epiphytic disc; reddish or pinkish ..... 4
3. Thallus erect; branched in a single plane; reddish ..... 5
   4. Individual discs becoming confluent upon contact; thallus cell isodiametric ..... HETERODERMA (p. 34)
   4. Individual discs overgrowing one another on contact; thallus cells elongated vertically ..... DERMATOLITHON (p. 35)
5. Main axes dichotomously branched with pinnate branchlets or irregularly branched ..... CORALLINA (p. 35)
5. Branching dichotomous throughout ..... JANIA (p. 35)
   6. Thallus consisting of uniseriate filaments, lacking corticating cells ..... 7
   6. Thallus otherwise ..... 24
7. Filaments unbranched ..... 8
7. Filaments branched ..... 10
   8. Thallus red; microscopic ..... ERYTHROTRICHIA (p. 30)
   8. Thallus green ..... 9
9. Thallus microscopic; cells with a single plastid ..... ULOTHRIX (p. 16)
9. Thallus readily visible; cells with a reticulate plastid which may be fragmented into discoid portions ..... CHAETOMORPHA (p. 19)
   10. Thallus microscopic; filaments closely adhering laterally to form a discoid thallus; epiphytic ..... 11
   10. Filaments remaining free from one another ..... 12
11. Disc green ..... ULVELLA (p. 16)
11. Disc red ..... ERYTHROCLADIA (p. 30)
   12. Filaments blue-green; thallus microscopic ..... ASTEROCYTIS (p. 29)
   12. Filaments green, brown or red ..... 13

13. Filaments green ..... 14
13. Filaments brown or red ..... 15
    14. Thallus microscopic; epiphytic ..... ENTOCLADIA (p. 16)
    14. Thallus readily visible; largely free living ..... CLADOPHORA (p. 20)
15. Filaments brown ..... 16
15. Filaments reddish ..... 19
    16. Thallus microscopic, occasionally visible as a brown fuzz on the host ..... 17
    16. Thallus readily visible ..... 18
17. Thallus erect, with a discoid basal system ..... MYRIOTRICHIA (p. 27)
17. Thallus largely prostrate; discoid basal system absent ..... STREBLONEMA (p. 25)
    18. Cells containing many discoid plastids ..... GIFFORDIA (p. 24)
    18. Cells containing a few band-shaped plastids ..... ECTOCARPUS (p. 23)
19. Thallus microscopic ..... 20
19. Thallus readily visible ..... 21
    20. Thallus pink; branches divergent; cells embedded in a thick matrix ..... GONIOTRICHUM (p. 29)
    20. Thallus red; branches dense, almost contiguous; cells not embedded in a thick matrix ..... ACROCHAETIUM (in part) (p. 31)
21. Thallus plumose; each cell of the main axis bearing a branch and successive cells bearing the branches on alternate sides ..... CALLITHAMNION (p. 39)
21. Thallus irregularly branched; every cell of the main axis not bearing a branch ..... 22
    22. Terminal cells of the filaments barrel-shaped ..... GRIFFITHSIA (p. 40)
    22. Ultimate cells of the filaments cylindrical ..... 23
23. Frond up to 1 cm long; epiphytic ..... ACROCHAETIUM (in part) (p. 31)
23. Frond larger than 1 cm long; not epiphytic ..... SPERMOTHAMNION (p. 40)
    24. Thallus consisting largely of a hollow tube ..... 25
    24. Thallus pluriseriate or solid, at least at the nodes ..... 30
25. Wall of tube composed of cells ..... 26
25. Wall of tube not cellular, consisting of a single unsegmented cavity of varying form ..... 28
    26. Wall of tube a single layer of cells; frond bright green ..... ENTEROMORPHA (p. 17)
    26. Wall of tube several layers of cells; frond reddish dull green ..... 27
27. Thallus hollow throughout ..... LOMENTARIA (p. 39)
27. Thallus constricted at intervals where the tube contains transverse diaphrams ..... CHAMPIA (p. 39)
    28. Thallus not composed of dichotomously branched tubes ..... 29
    28. Thallus composed of dichotomously branched tubes ..... DERBESIA (p. 21)
29. Thallus with a distinct main axis bearing pinnate branchlets ..... BRYOPSIS (p. 22)
29. Thallus an elongated stalk with a distal umbrella-shaped cap ACETABULARIA (p. 23)
    30. Thallus membranous; delicate; 1 to 2 cells thick ..... 31
    30. Thallus terete or flattened, but not membranous ..... 32
31. Thallus simple; purplish-red ..... PORPHYRA (p. 31)
31. Thallus simple or lobed; green ..... ULVA (p. 19)
    32. Axes filiform, diameter less than 1 mm ..... 33
    32. Axes filiform or flattened, diameter greater than 1 mm ..... 40
33. Thallus unbranched or only very occasionally branched ..... 34
33. Thallus branched ..... 35
    34. Thallus brown; usually epiphytic on *Diplanthera* ..... STICTYOSIPHON (p. 27)
    34. Thallus deep reddish-purple; forming mats in the littoral fringe and eulittoral zone ..... BANGIA (p. 30)
35. Filaments regularly dichotomous; tips of the filaments often incurved ..... 36
35. Filaments not regularly dichotomous ..... 37
    36. Filaments corticated only at the nodes ..... CERAMIUM (p. 40)
    36. Filaments corticated throughout ..... CENTROCERAS (p. 41)
37. Colorless trichoblasts absent; main axes completely corticated, but branchlets corticated only at nodes ..... SPYRIDIA (p. 42)

37. Colorless trichoblasts present; polysiphonous ..... 38
    38. Lateral branches short ..... **BRYOCLADIA (p. 45)**
    38. Lateral branches similar to main axes ..... 39
39. Thallus creeping; apices of main axis-inrolled ..... **HERPOSIPHONIA (p. 46)**
39. Thallus largely erect; apices of main axes not inrolled ..... **POLYSIPHONIA (p. 42)**
    40. Colorless trichoblasts generally present at apices of axes ..... 41
    40. Colorless trichoblasts absent ..... 43
41. Main axes of thallus densely covered by short lateral branches ..... **DIGENIA (p. 46)**
41. Lateral branches not densely covering the main axes of the thallus ..... 42
    42. Lateral branches short, blunt, and peg-like ..... **LAURENCIA (p. 48)**
    42. Lateral branches constricted at the base, often spindle-shaped ..... **CHONDRIA (p. 47)**
43. Thallus brown ..... 44
43. Thallus red, brownish red or green, but seldom brown ..... 48
    44. Thallus distinctly flattened ..... 45
    44. At least the main axes of the thallus terete ..... 47
45. Thallus dichotomously branched ..... **DICTYOTA (p. 26)**
45. Thallus not dichotomously branched ..... 46
    46. Thallus strap-shaped ..... **PETALONIA (p. 28)**
    46. Thallus fan-shaped ..... **PADINA (p. 26)**
47. Thallus with terete axes which bear leaf-like lateral branches and berry-like floats ..... **SARGASSUM (p. 28)**
47. Thallus terete throughout; thallus composed of filaments embedded in mucilage which give the thallus a slippery texture ..... **CLADOSIPHON (p. 27)**
    48. Thallus bright reddish-purple ..... 49
    48. Thallus brownish-red or greenish ..... 50
49. Thallus flattened; dichotomously branched; medulla cellular ..... **RHODYMENIA (p. 38)**
49 Thallas terete; irregularly branched; medulla filamentous ... **AGARDHIELLA (p. 36)**
    50. Axes with a single apical cell ..... 51
    50. Axes without a single apical cell ..... 53
51. Axes terete; short spine-like or stellate branchlets present; medulla cellular, without rhizines ..... **HYPNEA (p. 36)**
51. Axes terete or flattened; short spine-like or stellate branches absent; medulla cellular, rhizines present ..... 52
    52. Rhizines chiefly in central medulla; cystocarps unilocular with a single ostiole ..... **PTEROCLADIA (p. 33)**
    52. Rhizines chiefly in outer medulla; cystocarps bilocular with two ostioles ..... **GELIDIUM (p. 33)**
53. Axes flattened with pinnate lateral branchlets; medulla filamentous ..... **GRATELOUPIA (p. 36)**
53. Axes terete or flattened; medulla cellular ..... **GRACILARIA (p. 37)**

## MARINE FLOWERING PLANTS

1. Leaves terete ..... **CYMODOCEA (p. 49)**
1. Leaves flat ..... 2
    2. Leaves elliptical and produced in whworls of four to eight .... **HALOPHILA (p. 49)**
    2. Leaves of uniform width ..... 3
3. Leaves 5 to 10 mm wide ..... **THALASSIA (p. 49)**
3. Leaves 1 to 2 mm wide .....
    4. Leaves 1 to 1.5 mm wide with a single apical point ..... **RUPPIA (p. 49)**
    4. Leaves 1.5 to 2 mm wide with a toothed apex ..... **DIPLANTHERA (p. 49)**

## SYSTEMATIC ACCOUNT

### BENTHIC MARINE ALGAE

### DIVISION CHLOROPHYCOPHYTA

The green algae are grass-green in color since their pigment complement of chlorophylls a and b, carotenes and xanthophylls, which is similar to that of higher plants, is predominated by the chlorophylls. The pigments are contained in one to many plate-like, reticulate or discoid plastids per cell. Each cell contains one to many pyrenoids which are embedded in the plastids. The cells are uninucleate or multinucleate. The reserve food product is starch. The cell walls contain cellulose. Reproduction proceeds by swarmers with usually two or four[1] apically inserted, equal-length flagella.

#### Class CHLOROPHYCEAE

##### Order ULOTRICHALES

##### Family Ulotrichaceae

*Ulothrix flacca* (Fig. 19)

The plant consists of microscopic, unbranched, uniseriate filaments. The uninucleate cells contain a single, parietal, band-like plastid which more or less completely encircles the cell. One to three pyrenoids are embedded in the plastids. Reproduction proceeds by bi- or quadriflagellate swarmers.

The species was observed as an epiphyte on larger algae and sea grasses during early spring in Aransas and Redfish Bays. Rare.

Hygens (cited by Levring, 1957) showed that in Scandinavia long daylengths induced fusion of the swarmers and subsequent zygote formation, whilst short daylengths caused the swarmers to behave as zoospores and develop directly into new filaments. The zygotes did not germinate under long days but did so readily when transferred to short daylengths. Daylength variations thus appear to explain the observed winter-spring occurrence of the species in Scandinavia.

##### Family Chaetophoraceae

*Entocladia viridis* (Fig. 20)

The species consists of microscopic, branched, uniseriate filaments. The uninucleate cells contain a single, parietal, plate-like plastid with one to several pyrenoids. Reproduction takes place by bi- or quadriflagellate swarmers.

The plant occurred as an epiphyte on larger algae on the southwest jetty at Port Aransas and in Aransas and Redfish Bays throughout the year. Frequent. The alga was probably largely overlooked in nature since it often appeared as a contaminant in culture.

*Ulvella lens* (Fig. 21)

Minute, discoid green algae composed of radiating, laterally-united, branching

[1] Many, subapically inserted in *Derbesia*

filaments were ascribed to this species. The cellular characteristics were not determined.

The alga was found growing on shells and as an epiphyte on a larger alga. The species occurred in Aransas and Redfish Bays. Rare but probably overlooked.

There is a great deal of confusion concerning the delimitation of discoid green algal genera. Papenfuss (1962) discusses the problem at length and stresses the need for further information. Chihara (1957) studied the life-history of a species of *Pseudulvella* in culture and showed that the alga reproduced asexually by quadriflagellate swarmers.

Order Ulvales

Family Ulvaceae

*Enteromorpha* (Figs. 22–30)

The plants consist of simple or branched, monostromatic tubes which vary from capillary to inflated and bulbous in form. The algae initially consist of uniseriate filaments but soon become tubular. The uninucleate cells contain a single, parietal plastid with one to several pyrenoids. Most species have an isomorphic diplobiontic type of life-history, with dioecious sexual plants. Undifferentiated vegetative cells cleave to form biflagellate gametes or quadriflagellate zoospores.

Specific determinations within the genus are often difficult because of the variation in habit due to environmental conditions and to the age of the plant. Confusing intermediate forms between the species may be found frequently.

An extensive study of the European Ulvales, employing field and cultural studies, was conducted by Bliding (1963, 1968). A similar study of the local species of *Enteromorpha* and *Ulva* was recently conducted by Kapraun (1969), to whom the author expresses his gratitude for providing the information on which this account is largely based.

## KEY TO THE SPECIES

1. Thallus simple or sparsely branched ..... *Enteromorpha flexuosa*
1. Thallus with numerous branches ..... 2
   2. Branching chiefly near the base of the plant ..... *E. lingulata*
   2. Branching occurring throughout the plant ..... 3
3. Branching diffuse, but of one order, along the distinct main axis ..... 4
3. Branching proliferous and of several orders; branches successively smaller than the main axis ..... 5
   4. Branches proliferous and similar to the distinct main axis ..... *E. prolifera*
   4. Branches abruptly smaller than the main axis; the latter beset with numerous short spine-like branchlets 5 to 10 mm long ..... *E. salina*
5. Ultimate branches short, erect ..... *E. ramulosa*
5. Ultimate branches elongate ..... *E. clathrata*

*E. clathrata* (Fig. 23)

The plant is up to 30 cm long with axes up to 2.5 mm wide. The alga has numerous branches, each order of branching being smaller than the preceding. The

ultimate branches are elongate. The cells are arranged in distinct longitudinal series throughout the plant.

The species was found in the littoral fringe and eulittoral zone on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. The alga occurred throughout the year, but maximum development took place in winter and early spring. Common.

*E. flexuosa* (Fig. 24)

The plant is up to 20 cm long and has axes up to 1.5 cm wide. The alga is generally unbranched but is occasionally divided at the base into two or three similar axes. The axes taper to a filiform stipe below and are inflated distally. The cells are arranged in regular longitudinal rows below but are irregularly disposed distally.

The alga was observed in pools by the beach at the side of the southwest jetty at Port Aransas and in Aransas and Redfish Bays. The species was present from winter to early summer. Common.

*E. lingulata* (Fig. 25)

The plant consists of four to eight branches which arise near the base of the alga. The species is up to 7 cm long and has axes up to 3 mm wide, but the latter gradually dilate and are occasionally expanded up to 8 mm at the tips. The apices of the axes are often colorless through sporulation. The cells are arranged in distinct longitudinal and transverse rows throughout the plant.

The alga occurred in the eulittoral zone on the southwest jetty at Port Aransas, and in Aransas and Redfish Bays. The species was present throughout the year, maximum development taking place in early summer. Common.

*E. prolifera* (Figs. 26, 28, 29)

The plant is up to 30 cm long and has axes up to 5 mm wide. The alga has numerous branches which are similar to, and arise along the entire length of the main axis. The cells are arranged in longitudinal series in the younger parts but become less orderly with age.

The species was collected in pools by the beach at the side of the southwest jetty at Port Aransas and in Aransas Bay, during winter and early spring. Rare.

*E. ramulosa* (Fig. 22)

The plant is up to 10 cm long with axes up to 3 mm wide. The plants are abundantly branched, successive branches being smaller. The ultimate branches are short. The cells are irregularly arranged throughout the plant.

The species was found in the eulittoral zone on the southwest jetty at Port Aransas and in Aransas Bay. The alga occurred from winter to summer with maximum development proceeding in winter. Common.

*E. salina* (Figs. 27, 30)

The species is up to 15 cm long with axes up to 5 mm wide. The plant has a

single main axis along which short, spine-like branchlets of equal length are distributed. The cells are in longitudinal series throughout the plant.

The alga was collected in a pool by the beach at the side of the southwest jetty at Port Aransas. Rare.

*Ulva* (Figs. 31–33)

The plants consist of a simple or branched, distromatic membrane. The cellular and reproductive characteristics are similar to those of *Enteromorpha.*

KEY TO THE SPECIES

1. Plants divided into narrow, linear segments usually less than 1.5 cm wide ..... *U. fasciata*
1. Plants simple or with broad, irregular lobes ..... *U. lactuca*

*U. fasciata* (Fig. 32)

The thallus is up to 30 cm long and is divided into linear segments with undulate margins, usually less than 1.5 cm wide.

The alga was collected in the eulittoral zone on the southwest jetty at Port Aransas. The species was present throughout the year but demonstrated maximum growth in early summer. Common.

*U. lactuca* (Figs. 31, 33)

The thallus is up to 20 cm long and varies in form from simple to broadly lobed. The membrane is very delicate and is often perforated.

The alga was present in pools by the beach on the southwest jetty at Port Aransas, on the jetty itself, and in Aransas Bay, from winter to early summer. Common.

Order CLADOPHORALES

Family Cladophoraceae

*Chaetomorpha linum* (Figs. 34–38)

The plant consists of unbranched, uniseriate filaments 100–150 $\mu$ in diameter with cells of maximum length of one to two diameters. The species is attached by a basal cell which is approximately two to six times as long as the suprabasal cell and has a length of three to six diameters. The multinucleate cells contain a reticulate plastid which may become fragmented into discoidal portions. Several pyrenoids are present in each cell. Growth proceeds by diffuse cell divisions.

Köhler (1956) conducted a cytological and cultural study of *C. aerea* (= *C. linum*) and demonstrated an isomorphic diplobiontic type of life-history, with unmodified vegetative cells producing either biflagellate gametes or quadriflagellate zoospores.

The alga grows during the warmer months of the year in the littoral fringe and eulittoral zone on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. Common.

The species is composed of two forms. The first occurs on the relatively wave-

swept southwest jetty at Port Aransas and consists of filaments which are clearly basally attached. This form is often referred to a separate species, *C. aerea*. The second form occurs in the relatively calm waters of Aransas and Redfish Bays, entangled among larger algae and sea grasses, and basal cells are generally difficult to find. Collins (1908, 1909) considered *C. linum* and *C. aerea* to be synonymous. The genus is in need of revision since the major criterion for separating the species, whether the plants are basally attached or free and entangled, is probably artificial in most cases.

*Cladophora*

The plants consist of branched, uniseriate filaments which are attached by branching rhizoids. The multinucleate cells have a reticulate plastid containing several pyrenoids. Growth takes place by apical and intercalary cell divisions. Most species have a life-history of the isomorphic diplobiontic type, but some species have only asexual repetition of a single morphological phase. Reproduction proceeds by biflagellate and quadriflagellate swarmers (van den Hoek 1963).

The genus *Cladophora* contains extremely polymorphic species so that specific determinations are often difficult to make. Van den Hoek (1963) revised the European species by working along several lines of approach and achieved a more thorough understanding of the genus than had previously been attained. He stressed the importance of the type of thallus development. Species which grow by apical cell divisions and subsequent cell elongation demonstrate a regular type of organization as new branches arise at the apices of the filaments. Intercalary growth results in younger branches being intercalated between older ones so that the main axes are lined with branches of varying age. The ratio between apical and intercalary growth is an important taxonomic criterion, although it is influenced by water movement in many species. Apical growth is often dominant in agitated waters and intercalary growth in quiet waters. Van den Hoek is currently engaged in a revision of the *Cladophora* species of the eastern coast of the Americas and kindly provided the author with specific determinations of the local species.[1]

## KEY TO THE SPECIES

1. Plant sparingly branched ..... *C. ruchingeri*
1. Plant abundantly branched ..... 2
    2. Main axes from 200 to 300$\mu$ diameter ..... *C. vagabunda*
    2. Main axes up to 150$\mu$ diameter ..... 3
3. Main axes 85 to 150$\mu$ diameter ..... *C. dalmatica*
3. Main axis 30 to 60$\mu$ diameter ..... 4
    4. Plant with acropetally organized, terminal, branch systems ..... *C. albida*
    4. Plant with predominantly intercalary growth ..... *C. delicatula*

*C. albida* (Figs. 39, 45)

The plants are up to 7 cm long and are dark green. The thallus has distinctly

[1] The specific limits as determined by van den Hoek frequently differ from those previously recognized, so that no attempt has been made to "match up" the species with those given by Taylor (1957, 1960).

acropetally organized, terminal, branch systems with the branchlets unilaterally inserted on the main axis. The main axes are 25 to 60 $\mu$ in diameter.

The species was found in the upper eulittoral zone on the southwest jetty at Port Aransas during winter and early spring. Frequent.

*C. dalmatica* (Figs. 40, 41, 46)

The plants are up to 20 cm long and vary in color from bright to dark green. The thallus has acropetally organized, terminal, branch systems with the branchlets occasionally unilaterally inserted on the main axes. The main axes are 85 to 150 $\mu$ in diameter.

The plant was present throughout the year, largely in Aransas Bay. Common.

*C. delicatula* (Fig. 42)

The plants are up to 9 cm long and pale to bright green. The thallus is irregularly branched due to a preponderance of intercalary growth. The main axes are 30 to 35 $\mu$ in diameter.

The species was collected during the summer on rocks and as an epiphyte on larger algae and sea grass. It occurred on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. Frequent.

*C. ruchingeri* (Figs. 43, 47)

The plants are up to 5 cm long and dark green. The thallus grows largely by intercalary growth but is very sparingly branched. The main axes are up to 200 $\mu$ in diameter.

The species was found in the eulittoral zone on the southwest jetty at Port Aransas. Rare.

*C. vagabunda* (Figs. 44, 48)

The plants are up to 18 cm and dark green. The thallus has distinctly acropetally organized, terminal, branch systems with the branchlets unilaterally inserted on the main axis. The main axes are 200 to 300 $\mu$ in diameter.

The species was found throughout the year in the eulittoral zone on the southwest jetty at Port Aransas, and in Aransas and Redfish Bays. Common.

Order Codiales

Family Derbesiaceae

*Derbesia vaucheriaeformis* (Figs. 49, 50)

The plant consists of dichotomously branched, coenocytic tubes with many nuclei and discoidal plastids containing pyrenoids. The spherical reproductive organs are borne laterally along the tubes and release swarmers with an anterior circle of flagella.

The alga was collected in the sublittoral zone on the southwest jetty at Port Aransas during the summer. Vegetative specimens and those with reproductive organs were observed. Rare.

Cultural studies have demonstrated that certain species of *Derbesia* have a

heteromorphic, diplobiontic type of life-history. The zoospores produced by the *Derbesia* phase develop into a *Halicystis* phase consisting of a coenocytic, vesicular thallus with a short rhizoid and forming biflagellate gametes. Kornmann (1938) showed an alternation between *D. marina* and *H. ovalis;* and Feldmann (1950) and Ziegler and Kingsbury (1964) linked *D. tenuissima* and *H. parvula* in the same life-history. The story, however, is complicated by the report of Hustede (1960) that *Derbesia neglecta* alternates with *Bryopsis halymeniae.* The alternate, if any, of *D. vaucheriaeformis* is unknown.

Family BRYOPSIDACEAE

*Bryopsis* (Figs. 51–55)

The plants consist of pinnately branched, coenocytic tubes attached by rhizoids. The thallus contains many nuclei and discoidal plastids which contain pyrenoids. The lateral branchlets may become cut off from the main axis and function as gametangia.

Conflicting reports concerning the nature of the life-history of *Bryopsis* species are present in the literature. Zinnecker (1935), on the basis of cytological studies, concluded that *B. plumosa* is a diploid haplobiont, with meiosis taking place during gametogenesis. Neumann (1969) demonstrated gametogenic meiosis in a second species, *B. hypnoides.* However, Hustede (1960) studied *B. halymeniae* in culture and demonstrated a heteromorphic, diplobiontic type of life-history, involving *Derbesia neglecta* as the sporophyte. Both types of life-history may possibly occur within the genus, but further studies are urgently required.

KEY TO THE SPECIES

1. Branchlets distinct in size from the lesser branches; main axes up to 1 mm diameter ..... *B. plumosa*
1. No marked difference in size between the branchlets and the lesser branches; main axes up to 0.5 mm in diameter ..... *B. hypnoides*

*B. hypnoides* (Figs. 51, 52)

The plant forms dense, dark green tufts up to 4.5 cm long. The thallus is soft in texture, is usually triangular in form and up to 2.5 cm wide; however, the frond is often lanceolate in outline. The main axes are simple or branched. The lower branchlets are elongated and often surround the apex of the thallus. The branchlets do not differ markedly from the lesser branches in size. The main axes are up to 0.5 mm in diameter.

The species was collected in the sublittoral zone on the southwest jetty at Port Aransas during the warmer part of the year. Common.

*B. plumosa* (Figs. 53–55)

The plant forms loose, dark green tufts up to 7 cm long. The thallus is more rigid than that of the preceding species. The main axes are simple or branched. The thallus is variable in form, but is usually lanceolate and up to 5 mm wide; the plants are occasionally triangular. The lesser branches are much wider than the branchlets. The main axes are up to 1 mm in diameter.

The alga was collected in the sublittoral zone on the southwest jetty at Port Aransas during the warmer part of the year. Rare.

Order DASYCLADALES

Family Dasycladaceae

*Acetabularia crenulata* (Figs. 56, 57)

The alga is calcified and consists of an unbranched, white stipe, up to 4 cm long, which bears a concave, green disc, up to 1 cm diameter, at the apex. The uninucleate, diploid, vegetative thallus consists of a rhizoidal base and an erect axis which bears a whorl of deciduous, branched, hair-like appendages. The latter often leave scars on being shed. When reproduction begins, the nucleus divides to give daughter nuclei which move up into a whorl of developing, gametangial rays at the apex of the stipe. The gametangial rays are laterally adpressed to form the disc. Uninucleate cysts are formed within each gametangium and are later released. Meiosis takes place within each cyst to give rise to haploid, biflagellated gametes. Fusion of the gametes results in a diploid zygote which reconstitutes the thallus. Thus, the alga has a diploid, haplobiontic type of life-history.

The alga was found attached to oyster shells in Aransas and Redfish Bays during the warmer part of the year. Common.

The life-history was determined by Hämmerling (1934) in *A. mediterranea*. *Acetabularia* is a valuable alga for the study of mechanisms of inheritance and the interplay of the nucleus and cytoplasm and a considerable amount of research has been conducted with the organism. Its value resides largely in its ability to regenerate excised parts and in the relative ease with which the nucleus and cytoplasm may be separated. Accounts of the research conducted with *Acetabularia* are presented by Hämmerling (1953), Brachet (1965) and Gibor (1966).

## DIVISION PHAEOPHYCOPHTA

The brown algae have a characteristic brownish color since the carotenoid pigment fucoxanthin masks the remaining pigments, chlorophylls a and c, other carotenes and xanthophylls. The pigments are contained in one to many plate-like, ribbon-like, or discoid plastids per cell. Pyrenoids may be associated with the plastids. The cells are uninucleate. The reserve food products are mannitol and laminarin. The cell walls contain cellulose, algin and pectin. Motile reproductive cells with two laterally inserted flagella of unequal length are present in the majority of the local members of the group. *Dictyota* and *Padina* in addition have non-motile reproductive cells.

Class PHAEOPHYCEAE

Order ECTOCARPALES

Family Ectocarpaceae

*Ectocarpus siliculosus* (Figs. 58–61)

The plants consist of branched, uniseriate filaments which form tufts up to 16

cm long. The cells contain a small number of simple or forked, band-shaped plastids in which pyrenoids are embedded or to which they are attached by protoplasmic strands. The unilocular reproductive organs are ellipsoid. The plurilocular organs are variable in form but are usually greatly elongated and terminate in a colorless hair. Specimens with shorter plurilocular organs without a terminal hair are often referred to *E. confervoides* (Roth) Le Jolis, but in the present study both forms were considered as *E. siliculosus* since the two types of plurilocular organ intergraded and were occasionally found on the same specimen.

The alga occurred in Aransas and Redfish Bays in winter and early spring, attached to rocks, oyster shells and wooden pilings, and as an epiphyte on larger algae. Plurilocular organs were the only type of reproductive body observed in the species. Common.

The life-history of the species varies in different parts of the world (review in Russell, 1966). Papenfuss (1935) studied the alga at and near Woods Hole, Massachusetts, and described it as an isomorphic (tending to heteromorphic) diplobiont. Diploid, asexual plants bore plurilocular and unilocular organs. The swarmers from the former type of reproductive organ repeated the phase, but meiosis took place in the latter type to give haploid swarmers which developed into dioecious, sexual plants. The swarmers from the plurilocular gametangia of the sexual plants fused and the zygotes reconstituted the diploid, asexual phase. Since plants bearing plurilocular organs were the only type of individuals observed by the writer, the alga possibly consists of a single morphological phase which reproduces itself asexually by swarmers from plurilocular organs (Edwards 1969a).

*Giffordia* (Figs. 62–70)

The genus consists of plants with branched, uniseriate filaments whose cells contain many discoid plastids. Unilocular and plurilocular reproductive organs occur; the shape of the latter is of primary importance in the delimitation of the species within the genus.

## KEY TO THE SPECIES

1. Plurilocular organs with a pointed apex ..... *Giffordia rallsiae*
1. Plurilocular organs with a blunt apex ..... 2
    2. Plurilocular organs usually more than five diameters long ..... *G. indica*
    2. Plurilocular organs usually less than five diameters long ..... *G. mitchelliae*

*G. indica* (*G. duchassaingiana*) (Figs. 62, 66)

The plants generally form small tufts up to 4 cm long and may be readily recognized by their greatly elongated plurilocular organs which are usually more than five diameters long, with blunt apices.

The alga was present throughout the year on rocks, or as an epiphyte on larger algae on the southwest jetty at Port Aransas. Plurilocular organs were the only type of reproductive body observed. Frequent.

*G. mitchelliae* (Figs. 63, 65, 67–69)

The plants generally form large tufts up to 16 cm long. The plurilocular organs, with their blunt apices, are similar in form to those of the preceding species but are much shorter, usually less than five diameters long. The unilocular organs are oblong in profile.

The species occurred throughout the year on rocks, oyster shells and wooden pilings and as an epiphyte on larger algae and sea grasses. The alga was found on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. Plurilocular organs was almost invariably observed. Unilocular organs were collected on only two occasions. Common.

*G. rallsiae* (Figs. 64, 70)

The alga generally forms very small tufts up to 0.5 cm long, but occasionally the tufts were up to 2 cm tall. The short plurilocular organs with pointed apices are very distinctive.

The species occurred throughout the year on oyster shells and wooden pilings, and as an epiphyte on larger algae. The plant was collected on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. Plurilocular organs were the only type of reproductive body observed. Common.

*Streblonema* (Figs. 71–73)

The plants consist of branched, uniseriate filaments which grow upon or penetrate the surface of larger algae. *Streblonema* is normally invisible to the naked eye but occasionally forms a very small brown fuzz on the host just visible to the naked eye. The thallus is largely creeping with a poorly developed system of erect filaments. Colorless hairs may be present. The cells possess a small number of discoid or band-shaped plastids. Plurilocular organs were the only type of reproductive organs observed in the two species found during the study, but unilocular organs reportedly occur in some species.

It is difficult to determine the morphological attributes of *Streblonema* species when growing on their host. The algae were isolated into culture so that they could be observed more easily.

## KEY TO THE SPECIES

1. Plurilocular organs uniseriate ..... *Streblonema oligosporum*
1. Plurilocular organs uniseriate to biseriate ..... *S. sp.*

*S. oligosporum* (Fig. 71)

The species has elongated, colorless hairs. The uniseriate plurilocular organs are elongated with a uniform diameter and have blunt apices.

The alga was epiphytic on larger algae during winter and spring on the southwest jetty at Port Aransas and in Aransas Bay. Frequent.

*S. sp.* (Figs. 72, 73)

The plants also have elongated, colorless hairs. The plurilocular organs are uniseriate to biseriate and are longer than those of the preceding species. They

do not have a uniform diameter but tend to taper distally. The specific identity of the species remains obscure.

The species was found growing epiphytically on *Rhodymenia pseudopalmata* on the southwest jetty at Port Aransas. Rare.

Order Dictyotales

Family Dictyotaceae

*Dictyota dichotoma* (Figs. 74–77)

The alga consists of flat, dichotomously branched fronds with smooth margins, up to 18 cm long, which are attached by a short stipe. The plant grows by means of a single apical cell at the apex of each branch. The species is of parenchymatous construction and consists of three cell layers; a single layer of large, colorless, medullary cells is flanked on each side by a layer of smaller pigmented cortical cells. Hairs are scattered over the surface of the thallus in inconspicuous tufts. The species is an isomorphic diplobiont. The reproductive organs are borne on both surfaces of the frond. The sexual plants are dioecious. The male gametangia or antheridia are plurilocular organs which are grouped into colorless sori; they release motile, uniflagellate gametes. The female gametes are non-motile eggs and are borne singly in oogonia which form dark-brown sori. The asexual phase produces nonmotile spores in tetrasporangia which are scattered singly or in small groups over the frond.

The alga was found in the sublittoral zone on the southwest jetty at Port Aransas and in Aransas and Redfish Bays during the warmer months of the year. Vegetative, female and tetrasporic specimens were observed. Common.

The life-history of the species was first determined by Hoyt (1910). Cultures were started in the laboratory by allowing fertilized eggs and tetraspores to fall onto oyster shells where they germinated and began to grow. The shells were subsequently transferred to nature where the development of the plants was followed. Since shells to which tetraspores had attached bore only sexual plants, a diplobiontic life-history was inferred. *Dictyota dichotoma* produces its gametes in regular periodic crops in relation to the tidal cycle. One crop per month is developed at Beaufort, North Carolina, which is liberated three to six days after the greatest spring tide (Hoyt 1907). The periodicity at Port Aransas was not ascertained.

*Padina vickersiae* (Figs. 78, 79)

The plant consists of a flat, fan-like blade up to 20 cm long. The thallus is entire when young but later generally becomes split into spatulate segments. The base of the alga consists of a short, rounded stipe which is attached to the substratum by a basal disc. The distal margin of the frond is inrolled. The plant is of parenchymatous construction and grows from a marginal row of apical cells. Internally, the thallus consists of a single layer of medullary cells in the apical regions of the thallus, two layers throughout most of the plant and up to six layers in the lower regions. The medulla is covered by a single layer of cortical cells on each surface of the frond. The surface of the latter bears concentric rows of hairs parallel with

the margins of the thallus. The life-history and reproductive characteristics are similar to those of *Dictyota*, except for the arrangement of the tetrasporangia which are produced in sori like the oogonia.

The plant was found in the sublittoral zone on the southwest jetty at Port Aransas and in Aransas Bay. It was present throughout the year, but maximum development occurred during the warmer months. Vegetative, male, female and tetrasporic specimens were observed. Common.

The life-history of the species was determined by Wolfe (1918) who used the method devised by Hoyt (1910) for *Dictyota dichotoma.*

Order Chordariales

Family Chordariaceae

*Cladosiphon occidentalis* (Figs. 80–83)

The plant consists of terete, branched axes up to 2 mm wide and up to 20 cm long. The construction is pseudoparenchymatous; the axes are composed of many filaments enclosed in mucilage which gives the plant a slippery texture. The central axial filaments form the medulla and produce lateral photosynthetic filaments bearing colorless hairs which comprise the cortex. Growth proceeds largely through intercalary cell divisions which are restricted to zones at the bases of the colorless hairs (trichothallic growth) in the cortex. Unilocular sporangia are produced at the bases of the peripheral photosynthetic filaments. The plurilocular organs are formed at the tips of the latter and are branched, pluriseriate structures.

The species was present in Redfish Bay during early spring. Unilocular and plurilocular organs were observed on the same individual. Rare.

Order Dictyosiphonales

Family Striariaceae

*Stictyosiphon subsimplex* (Figs. 84–86)

The plants consist of terete, simple to sparingly branched axes up to 1 mm wide and up to 9 cm long. The alga is of parenchymatous construction. The axis is solid in transection with a medulla composed of four large cells surrounded by a smaller-celled cortex which bears colorless hairs. The alga grows largely by diffuse cell divisions. Unilocular and plurilocular organs are formed on the surface of the plant.

The alga was found on oyster shells and as an epiphyte on *Diplanthera wrightii* in Aransas and Redfish Bays in winter and early spring. Unilocular and plurilocular organs were observed. Frequent.

Family Punctariaceae

*Myriotrichia subcorymbosa* (Figs. 87, 88)

The plant consists of uniseriate, branched filaments, up to 2 mm long, which arise from a discoid basal system. Colorless hairs with basal intercalary meristems are present. The cells contain several plate-like plastids. Plurilocular re-

productive organs are the only type of reproductive structure ever observed in the species.

The alga was collected as an epiphyte on *Diplanthera wrightii* in Redfish Bay. Maximum development occurred during the spring. Plurilocular organs were observed. Frequent.

Earle (1969) suggested that *Stictyosiphon subsimplex* and *Myriotrichia subcorymbosa* may be different phases in the life-history of the same alga. Wynne (personal communication) has obtained evidence from cultural studies that the two "species" are heteromorphic phases of a single alga.

Order Scytosiphonales

Family Scytosiphonaceae

*Petalonia fascia* (Figs. 89, 90)

The plants consist of flat, lanceolate blades up to 2.5 cm wide and up to 20 cm long. The blade tapers sharply to a terete, filiform stipe which is attached to a basal, discoid holdfast. The surface of the alga bears colorless hairs. The species is of parenchymatous construction and grows by diffuse cell divisions. A medulla of large colorless cells to the center of the blade is covered by a surface layer of smaller cortical cells which contain a single parietal plastid with a large pyrenoid. Plurilocular organs, the only type of reproductive structures observed in the species, are densely packed into sori which cover large areas of the blade.

The plant occurred in the eulittoral zone on the southwest jetty at Port Aransas during winter and early spring. Plurilocular organs were observed. Common.

Cultural studies have demonstrated the presence of an inconspicuous alternate phase in the life-history of the species. Wynne (1969) reported a crustose *Ralfsia*-like phase in the species from the Pacific coast of North America. Cultural studies with *Petalonia* from Port Aransas indicate that the alga passes the warmer months of the year as a filamentous or discoidal alternative phase, but none was observed in nature (Edwards 1969a).

Order Fucales

Family Sargassaceae

*Sargassum* (Figs. 91, 92)

The genus is one of the most highly differentiated in the algae and approaches the higher plants in the organization of the thallus. The terete, branched axes bear leaf-like organs with a midrib, toothed margins and a petiole-like base. Spherical, air-filled vesicles are borne on short stalks. The construction is parenchymatous and growth is initiated by the division of a single apical cell in each branch.

## KEY TO THE SPECIES

1. Leaves 1 to 2 mm wide with very fine teeth; vesicles with a spine-like projection ..... *Sargassum natans*
1. Leaves 3 to 4 mm wide with broad teeth; vesicles without a spine-like projection ..... *S. fluitans*

*S. fluitans* (Fig. 91)

The species may be readily recognized by its lanceolate leaves 3 to 4 mm wide. The teeth are pointed but have a broad base. The vesicles lack a spine-like projection.

*S. natans* (Fig. 92)

The alga has narrower leaves than the preceding species. The lanceolate leaves are 1 to 2 mm wide. The teeth are pointed and slender. The vesicles have a prominent spine-like apical projection.

The two local species do not occur attached but drift in from the Gulf of Mexico, often in large quantities. The two species are generally associated. Both are known only in the pelagic state and persist in a permanent vegetative condition.

## DIVISION RHODOPHYCOPHYTA

The characteristic red color of the group is due to the presence of the accessory pigments, phycoerythrin and phycocyanin, which mask chlorophylls a and d, the carotenes and xanthophylls. In contrast to the green and brown algae, color is an unreliable criterion for many genera, which often assume a greenish or brownish color. The pigments are contained in one to many stellate, plate-like or discoid plastids per cell, which may contain pyrenoids. The cells may be uni- or multinucleate. The reserve food product is floridean starch. The cell walls contain cellulose and pectin. Motile reproductive cells are absent from the group.

Class RHODOPHYCEAE

Subclass BANGIOPHYCIDAE

Order GONIOTRICHALES

Family Goniotrichaceae

*Asterocytis ramosa* (Fig. 93)

The plant consists of microscopic, branched, uniseriate, blue-green filaments. The uninucleate cells have thick, gelatinous walls and contain a single stellate plastid and a pyrenoid. Reproduction proceeds asexually by monospores.

The alga was not observed in nature but developed as a contaminant in a culture of larger algae collected in Redfish Bay. Rare.

*Goniotrichum alsidii* (Fig. 94)

The plant consists of microscopic, branched, uniseriate, pink filaments. The uninucleate cells have thick, gelatinous sheaths and contain a single stellate plastid with a pyrenoid. Reproduction proceeds asexually by monospores.

The alga occurred as an epiphyte on larger algae on the southwest jetty at Port Aransas and in Aransas and Redfish Bays during the warmer part of the year. Common.

The growth and reproduction of an isolate from Redfish Bay were studied in

culture in varying light intensity, daylength and temperature regimes (Edwards 1969a).

Order BANGIALES

Family Erythropeltidaceae

*Erythrocladia subintegra* (Fig. 95)

The alga consists of microscopic, branched, uniseriate filaments which are laterally compacted to form a red disc. The uninucleate cells contain a single stellate plastid with a pyrenoid. Reproduction takes place asexually by monospores.

The plant was observed as an epiphyte on larger algae on the southwest jetty at Port Aransas and in Aransas Bay. It was present throughout the year, but maximum development occurred in summer. Common.

A detailed study of the morphology and reproduction of the species in culture was conducted by Nichols and Lissant (1967), who obtained one of their isolates from Aransas Bay. The growth and reproduction of isolates from the southwest jetty at Port Aransas were studied in culture under varying light intensity, daylength and temperature regimes (Edwards 1969a)

*Erythrotrichia carnea* (Figs. 96, 97)

The plant consists of microscopic, unbranched, uniseriate, red filaments. The uninucleate cells contain a single stellate plastid with a pyrenoid. Reproduction proceeds asexually by monospores which are cut off by an oblique wall near the distal end of a vegetative cell.

The alga was collected as an epiphyte on larger algae and sea grasses on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. It occurred throughout the year, but maximum growth took place in summer. Common.

Family Bangiaceae

*Bangia fuscopurpurea* (Figs. 98–101)

The plant consists of unbranched, reddish-purple filaments which may reach a length of several centimeters. The young filaments are uniseriate but soon become pluriseriate. The uninucleate cells contain a single stellate plastid with a pyrenoid. Two types of spores are formed. Large pigmented $\alpha$ spores and smaller colorless $\beta$ spores, on separate filaments. The species has a heteromorphic diplobiontic type of life-history. The alternate phase *Conchocelis* consists of microscopic, uniseriate, branched filaments and reportedly inhabits shells.

The species formed blackish-purple mats on the rocks in the littoral fringe and eulittoral zone on the southwest jetty at Port Aransas during winter and early spring. The *Bangia* phase was observed to produce $\alpha$ and $\beta$ spores. The *Conchocelis* phase was not seen in nature. Common.

Richardson and Dixon (1968) completed the life-history of the species in culture and discovered that daylength controls the interconversion between the heteromorphic phases. *Bangia* produced the *Conchocelis* phase in daylengths longer than 12 hours, whilst daylengths of less than 12 hours induced the forma-

tion of the *Bangia* phase from *Conchocelis*. Edwards (1969a) obtained the *Conchocelis* phase of an isolate from Port Aransas in culture, but did not complete the life-history.

The evidence for sexuality in the genus is inconclusive. At the present time it seems best to follow Conway (1964) who called the large pigmented spores (in *Porphyra*, but the same terminology may be applied to *Bangia*) which are often referred to as carpospores, $\alpha$ spores, and the smaller pigmented spores which are often referred to as spermatia, $\beta$ spores.

*Porphyra leucosticta* (Figs. 102–105)

The plant consists of a delicate, monostromatic, membranous blade up to 13 cm long. The reddish-purple blade varies from rounded to oblong. The uninucleate cells contain a stellate plastid with a pyrenoid. The large pigmented $\alpha$ spores and the smaller colorless $\beta$ spores are produced by the same individual in strips in the distal portion of the blade. The species resembles *Bangia* in that it has a heteromorphic diplobiontic life-history with an alternating *Conchocelis* phase.

The alga occurred in the littoral fringe and eulittoral zone on the southwest jetty at Port Aransas during winter and early spring. Alpha and $\beta$ spores were observed. The *Conchocelis* phase was not observed in nature. Common.

An alternative phase in the life-history of the species has been reported by Kornmann (1961), Conway (1961) and Sommerfeld (personal communication). The latter researcher completed the life-history of an isolate from Woods Hole, Massachusetts, in culture and implicated variations in daylength as a controlling factor. The life-history of an isolate from Port Aransas was completed in culture and the effects of variations in light intensity, daylength and temperature on the alga were determined (Edwards 1969a).

Subclass FLORIDEOPHYCIDAE

Order NEMALIALES

Family Acrochaetiaceae

*Acrochaetium* (Figs. 106–114)

The plants consist of uniseriate, branched filaments with erect, free branches, which often bear colorless hairs. The cells contain single stellate, plate-like or lobed plastids with or without pyrenoids. The presence of sex organs has been reported for certain species, but monospores were the only type of reproductive body observed during the study.

The nature of the basal system constitutes a major criterion for the separation of the species, as may be seen from the key below. Since the plants of a particular species often grow densely on a given host, it was often necessary to resort to the use of culture to make a positive identification.

Aziz (1965) monographed the genus in the southeastern United States. West (1968) studied the morphology and reproduction in culture of a species from the Pacific coast of North America, which has an alternation of generations.

## KEY TO THE SPECIES

1. Base of the plant composed of a single cell ..... 2
1. Base of the plant composed of filaments or of a parenchymatous disc ..... 3
   2. Plant less than 200 $\mu$ long; colorless hairs usually present ..... *A. crassipes*
   2. Plant more than 200 $\mu$ long; colorless hairs absent ..... *A. hoytii*
3. Base of the plant a parenchymatous disc; colorless hairs usually present ..... *A. virgatulum*
3. Base of the plant composed of filaments which are sometimes aggregated in the center to form a disc ..... 4
   4. Monosporangia in series on the upper sides of the branches ..... *A. seriatum*
   4. Monosporangia irregularly arranged ..... *A. flexuosum*

*A. crassipes* (*Kylinia crassipes*) (Fig. 106)

This minute species is less than 200 $\mu$ long and is not readily visible to the naked eye. A short, unbranched or branched filament arises from the single basal cell. The filaments are often terminated by a colorless hair. Reproduction proceeds by monospores.

The alga occurred throughout the year as an epiphyte on larger algae, mainly on the southwest jetty at Port Aransas. Common.

The growth and reproduction of the species were followed in culture in varying light intensity, daylength and temperature regimes (Edwards 1969a).

*A. flexuosum* (Figs. 107, 108, 111)

The filamentous basal system gives rise to erect, branched filaments which do not bear colorless hairs. The plants often occur in such abundance as to form a red fuzz on the host up to 3 mm long. Reproduction proceeds by monospores.

The species was collected throughout the year as an epiphyte on larger algae on the southwest jetty at Port Aransas and in Aransas Bay. Common.

The growth and reproduction of the species were studied in culture under varying conditions of light intensity, daylength and temperature (Edwards 1969a).

*A. hoytii* (Figs. 109, 112)

The plant has a unicellular basal system from which erect, branched filaments arise. Colorless hairs are absent. Reproduction takes place by monospores.

The alga was collected as an epiphyte on *Dictyota dichotoma* on the southwest jetty at Port Aransas during the summer. Frequent.

*A. seriatum* (Fig. 110)

The filamentous basal system of the plant is frequently aggregated to form a disc in the center. The erect, branched filaments do not bear colorless hairs. The monosporangia are arranged in distinct series on the upper sides of the branches.

The species was collected as an epiphyte on larger algae on the southwest jetty at Port Aransas during the summer. Frequent.

*A. virgatulum* (Figs. 113, 114)

The alga has a parenchymatous, discoid basal system which gives rise to erect, branched filaments. The erect filaments often bear colorless hairs. The plants

often occur in such abundance as to form a red fuzz on the host up to 2 mm long. Reproduction is by monospores.

The plant was found as an epiphyte on *Diplanthera wrightii* in Redfish Bay during the warmer months of the year. Common.

## Order Gelidiales

### Family Gelidiaceae

The plant consist of erect, branched axes which are stiff and cartilaginous in consistency. The structure is uniaxial so that a single apical cell terminates each branch. Internally, the axis consists of a large-celled medulla to the center and a smaller-celled cortex to the periphery. Thick-walled filaments called rhizines arise as outgrowths of the medullary cells, and grow downward and penetrate between the cells. The position of the rhizines in the medulla is held to have a diagnostic value, although it is somewhat variable. The sexual plants are dioecious. The carpogonial branch develops inside the axis just behind the apex; following fertilization the carposporophyte develops and causes the frond to swell. The number of locules in the carposporophyte and the number of ostioles connecting it to the exterior constitute the most reliable distinction between *Gelidium* and *Pterocladia*. However, since carposporophytes are not of common occurrence, less reliable characters must frequently be resorted to in order to separate the two genera. The antheridia consist of small, colorless cells and form sori on the surface of the axis behind the apex. The tetrasporangia, which are cruciately divided, are developed in the cortex at the apices of the swollen, fertile axes.

Dixon (1958, 1959) studied the development of the thallus of *Gelidium* and *Pterocladia* and the development of the reproductive organs of *Gelidium* from the British Isles.

*Gelidium crinale* (Figs. 115–119)

The plant forms dense, dark reddish-purple patches up to 9 cm long. The alga is extremely variable in form. The axes, which are less than 0.5 mm diameter, may be terete and the plant irregularly branched or the axes may be flattened and the plant pinnately branched. The rhizines are largely confined to the outer portion of the medulla. The carposporophyte is located in the center of the axis and has two locules, each of which communicates with the exterior by an ostiole or pore.

The plant grows on rocks and wooden pilings on the southwest jetty at Port Aransas, and in Aransas and Redfish Bays. The alga occurs largely in the eulittoral zone and grows well throughout the year. Vegetative, male, cystocarpic and tetrasporic specimens were found. Common.

*Pterocladia* (Figs. 120–122)

The major criterion which separates the genus from *Gelidium* is the nature of the carposporophyte, which in *Pterocladia* forms a unilateral swelling on the axis, has a single locule and a single pore to the exterior. In addition, the rhizines are largely confined to the center of the medulla.

## KEY TO THE SPECIES

1. Main axes to 0.5 mm wide ..... *P bartlettii*
1. Main axes 1 to 3 mm wide ..... *P. capillacea*

*P. bartlettii* (Figs. 120, 122)

The plant has flattened axes, is up to 4 cm tall and is reddish-purple. The alga is pinnately branched with the main axes to 0.5 mm wide.

The alga was found on the stone breakwater at Rockport during the summer. Male and tetrasporic specimens were found. Rare.

*P. capillacea* (*P. pinnata*) (Fig. 121)

The plant is robust, up to 15 cm tall, and is deep reddish-purple to almost black. The alga has flattened, pinnately branched axes, 1 to 3 mm wide.

The alga occurred in the eulittoral and sublittoral zones on the southwest jetty at Port Aransas throughout the year. Vegetative, carposporic and tetraporic specimens were collected. Common.

Morphological variations of the thallus due to habitat diversity and the time of the year are discussed by Dixon (1963) and Stewart (1968).

Order CRYPTONEMIALES

Family Corallinaceae

The members of the family are characterized by the deposition of calcium-magnesium carbonate in their cell walls, which give them the appearance of coral and a brittle texture. They require decalcification before they can be examined satisfactorily (see p. 5 for the procedure). The family has a multiaxial type of construction. The reproductive organs are borne in superficial cavities or conceptacles which open to the exterior by one to several pores. The sexual plants are dioecious and the female and male organs develop on the floor of the conceptacle. The tetrasporangia may be readily recognized by the zonate arrangement of the tetraspores.

The family is divided into two groups. In the first group, the crustose coralline algae, the thallus is composed of branched filaments which are laterally compacted to form a pseudoparenchymatous crust, *e.g.*, *Heteroderma* and *Dermatolithon*. In the second group, the articulated coralline algae, the basal portion of the thallus is discoid and produces erect, terete to flattened axes which generally branch in a single plane. The axes are branched and segmented, with calcified segments alternating with non-calcified flexible articulations, *e.g.*, *Corallina* and *Jania*.

An account of the crustose coralline algae on the Pacific coast of North America was given by Mason (1953). Johansen (1969) discussed the articulated coralline algae.

*Heteroderma lejolisii* (*Fosliella lejolisii*) (Fig. 123)

The plant forms a very thin, pinkish crust up to 3 mm diameter, which is at first circular but later becomes irregular. Adjacent thalli become confluent but

are never superimposed. The vegetative part of the thallus is monstromatic with isodiametric cells. The conceptacles form swellings on the surface of the crust and open by a single pore.

The alga was collected as an epiphyte on *Thalassia testudinum* and occasionally on larger algae in Redfish Bay. Vegetative and tetrasporic specimens were observed. Common.

*Dermatolithon pustulatum* (*Lithophyllum pustulatum*) (Figs. 124, 125)

The plant forms circular or irregular, pinkish-purple crusts up to 8 mm in diameter which often completely encircle the host. Adjacent thalli overgrow one another but do not become confluent. The vegetative portion of the thallus consists of one to three layers of vertically elongated cells, which cut off small "cover cells" on the surface of the crust. The conceptacles form swellings on the surface of the crust and open by a single pore.

The alga occurred as an epiphyte on larger algae and sea grasses. It was collected in the eulittoral and sublittoral zones on the southwest jetty at Port Aransas and in Redfish Bay. Female and tetrasporic specimens were collected. Common.

*Corallina* (Figs. 126–130)

## KEY TO THE SPECIES

1. Branching regularly dichotomous: segments flattened ..... *C. subulata*
1. Branching irregular; segments largely terete ..... *C. cubensis*

*C. cubensis* (Figs. 126, 127)

The plant forms pinkish-purple tufts up to 2 cm long. The axes are mainly terete and are loosely pinnate or irregularly branched.

The species was found in the lower eulittoral zone on the southwest jetty at Port Aransas and in Redfish Bay during the warmer part of the year. Vegetative specimens only were collected. Frequent.

*C. subulata* (Figs. 128–130)

The plant forms pinkish-purple tufts up to 3.5 cm long. The axes are distinctly flattened. The main axes are dichotomously branched, the branchlets being arranged pinnately. The conceptacles are swollen, terminate the branchlets and are often provided with one or two horn-like projections.

The alga was present throughout the year in the lower eulittoral zone on the southwest jetty at Port Aransas. Conceptacles were observed, but the type of reproductive bodies they bore was not determined. Common.

Specimens which appeared to be intergrades between the two species were occasionally found.

*Jania capillacea* (Fig. 131)

The plant is small and delicate, about 0.5 cm long, with terete axes up to 100 $\mu$ in diameter. The thallus is dichotomously branched at very wide angles. The segments are four to six diameters long. The conceptacles are flattened and are borne

at or near the ends of the terminal branches. They often bear two horn-like projections which develop into branches and open by a distinct apical pore.

The alga was collected as an epiphyte on a drift specimen of *Sargassum* in the surf at Port Aransas and in Redfish Bay. Conceptacles were observed but the type of reproductive structures they bore was not determined. Rare.

Family Cryptonemiaceae

*Grateloupia filicina* (Figs. 132–136)

The plant is up to 14 cm long, with flattened axes up to 3 mm wide. The thallus is variable in color, from green to brownish and reddish-purple, and has a slimy texture. The species is very polymorphic. The main axis is simple to irregularly branched with many marginal proliferations which give the thallus a pinnate appearance. The construction of the thallus is multiaxial. The medulla consists of anastomosing filaments which become compacted at their apices to form the small-celled cortex. The alga is reportedly monoecious. The antheridia form patches of small cells over the surface of the frond. The carposporophytes are small and inconspicuous and are immersed in the axes. The tetrasporangia are embedded in the outer cortex and are cruciately divided.

The alga was found attached to rocks and pilings throughout the year in the eulittoral zone on the southwest jetty at Port Aransas and in Aransas Bay. Vegetative, carposporic and tetrasporic specimens were collected. Common.

The causes of the variation in appearance of the thallus were discussed by Dixon (1963).

Order Gigartinales

Family Solieriaceae

*Agardhiella tenera* (Figs. 137–140)

The plant is large, up to 18 cm long, fleshy and bright reddish-purple. The branches are terete and taper from the center to their bases and apices. The alga is of multiaxial construction. The medulla consists of a core of parallel longitudinal filaments; the outer cortex consists of small cells, whilst the inner cortex is composed of larger cells. The latter cells produce downgrowing rhizoidal filaments which contribute to the medulla. The sexual plants are dioecious. The antheridia form sori on the axes of the plant. The carposporophytes are deeply embedded in the axes, but cause the branches to swell. The tetraporangia are scattered over the surface of the branches and are zonately divided.

The plant occurred in the sublittoral zone on the southwest jetty at Port Aransas. The species reached its maximum development during the warmer part of the year. Very large specimens up to 25 cm long and very pale were found in Redfish Bay during early spring. Vegetative, male, cystocarpic and tetrasporic specimens were collected. Common.

Family Hypneaceae

*Hypnea* (Figs. 141–147)

The genus contains large, irregularly branched plants with terete axes bearing

numerous short, spine-like or stellate branchlets. The structure is uniaxial and a single large apical cell terminates each branch. Internally, a persistent central filament can be recognized in the center of the large-celled medulla; a small-celled cortex surrounds the medulla. The sexual plants are dioecious. The antheridia form superficial sori. The cystocarps are almost spherical and form prominent swellings on the axes. The zonately divided tetrasporangia are scattered in the outer cortex of slightly swollen ultimate branchlets.

The species comprising the genus are extremely polymorphic and specific identifications are frequently difficult. The genus is in need of revision.

## KEY TO THE SPECIES

1. Axes covered with stellate branchlets; hooked branch tips absent ..... *H. cornuta*
1. Axes without stellate branchlets; branches often with hooked tips ..... *H. musciformis*

*H. cornuta* (Figs. 141–142)

The plant is up to 25 cm long and varies from dark-green to reddish-brown. The species may be readily recognized by the minute, stellate branchlets which clothe the axes. These are readily detached and develop into new individuals, thus constituting a means of asexually propagating the species.

The alga occurred in the eulittoral zone of the southwest jetty at Port Aransas and in Aransas and Redfish Bays during the warmer months of the year. Vegetative and tetrasporic specimens were collected. Common.

*H. musciformis* (Figs. 143–147)

The species is extremely variable in color and habit. The color varies from dark-green to reddish-brown. The plant has irregularly branched, main axes up to 20 cm long, which bear small, spine-like, scattered branchlets. The apices of the principal branches may be strongly curved and thickened to form tendrils. These function in a similar way to those of certain flowering plants by firmly attaching the plant to other algae or objects with which the algae comes into contact. However, the tendrils are frequently absent and the apices of the branches are merely curved. The plant is generally quite robust when growing in situations subject to wave action; in quiet waters the plant has axes of a smaller diameter and is more fragile.

The species occurred throughout the year in the eulittoral zone on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. Vegetative, male, carposporic and tetrasporic specimens were collected. Common.

Family Gracilariaceae

*Gracilaria* (Figs. 148–155)

The genus contains large, irregularly branched plants with terete or flattened axes. Internally, a medulla of large, colorless cells is surrounded by a cortex of smaller, pigmented cells. The structure is uniaxial, with a single large apical cell terminating each branch; a central axial filament is unrecognizable in the center of the medulla. The sexual plants are dioecious. The antheridia form superficial sori in shallow depressions on the surface of the branches in *G. foliifera*. The cystocarps form prominent hemispherical swellings which are scattered over

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the thallus. The cruciately divided tetrasporangia are scattered among the cortical cells of the branches.

The genus consists of species which are often extremely polymorphic so that it is frequently difficult to make specific determinations with confidence. The genus is in need of revision.

## KEY TO THE SPECIES

1. Frond flattened throughout, or the branches terete with only the portion immediately below a fork flattened ..... *G. foliifera*
1. Frond terete throughout ..... 2
   2. Ultimate branches coarse; frond not adhering well to paper upon drying .... *G. debilis*
   2. Ultimate branches fine; frond adhering well to paper ..... *G. verrucosa*

*G. debilis* (Fig. 148)

The alga is up to 30 cm long and varies from greenish to reddish-brown. The terete axes are branched in many planes, are coarse and do not taper distally to a great extent. The texture is cartilaginous and the alga does not adhere well to paper.

The plant was found in Redfish Bay throughout the year but was best developed in the warmer months. Vegetative specimens only were observed. Common.

*G. foliifera* (Figs. 149–151, 153–155)

The species is extremely variable with regard to the size of the plant, the degree of flattening of the axes, the manner and degree of branching, and the color. An indication of the range of form of the plant is presented in Figures 144–151. The alga is up to 30 cm long and is largely branched in one plane. The axes of the plant vary from distinctly flattened to terete, with flattened areas confined to just below the forkings of the branches. The color varies from dull green to dark reddish-brown.

The plant was present throughout the year in the lower eulittoral and sublittoral zones. It was found on the southwest jetty at Port Aransas and in Aransas and Redfish Bays. Vegetative, male, carposporic and tetrasporic specimens were collected. Common.

*G. verrucosa* (Fig. 152)

The alga is up to 20 cm long and varies from greenish to reddish-purple. The plant consists of terete axes which branch in many planes and which taper distally to form fine ultimate axes. The consistency of the alga is firmly fleshy and it adheres well to paper.

The plant was present in Redfish Bay throughout the year but demonstrated maximum development during the warmer part of the year. Vegetative specimens only were collected. Common.

Order Rhodymeniales

Family Rhodymeniaceae

*Rhodymenia pseudopalmata* (Figs. 156–159)

The plant consists of a flattened, dichotomously branched frond attached by a

basal stipe. The thallus is up to 10 cm long, the axes up to 5 mm wide and is bright reddish-purple. Internally, the medulla consists of large colorless cells surrounded by a small-celled pigmented cortex. The thallus is of multiaxial construction. The sexual plants are dioecious. The antheridia consist of superficial sori of small colorless cells. The cystocarps are hemispherical, very prominent and are scattered over the margins and surface of the frond. The cruciately divided tetrasporangia are embedded among the cortical cells in the distal portions of the branches.

The alga occurred in the sublittoral zone on the southwest jetty at Port Aransas. It was present throughout the year but demonstrated maximum growth during the warmer part of the year. Male, carposporic and tetrasporic specimens were collected. Common.

Family Champiaceae

*Lomentaria baileyana* (Figs. 160, 161)

The plant is branched, with hollow, terete axes which taper at each end. The frond is pinkish to purplish-red and is up to 1 cm long. The thin thallus wall consists of a loose layer of elongated, branched filaments bordering the internal tube, a single middle layer of large cells and an outer layer of small cells. The sexual plants are dioecious. The antheridia form sori at the apices of the branches. The prominent cystocarps are scattered over the surface of the frond. The tetrahedrally divided tetrasporangia are embedded in the cortex.

The alga was collected in the eulittoral zone on the southwest jetty at Port Aransas during the summer. Vegetative specimens only were collected. Rare.

*Champia parvula* (Figs. 162, 163)

The plant may be readily recognized by its branched, hollow thallus with constricted nodes. It is up to 10 cm long and greenish to reddish-purple. Thin, transverse cellular diaphragms are present at the nodes. The wall of the tubular thallus consists of an internal layer of loose, elongated, branched filaments, a single middle layer of large cells and an outer layer of small cortical cells. The sexual plants are dioecious. The antheridia are formed in superficial sori. The cystocarps are prominent and are scattered over the thallus surface. The tetrahedrally divided superficial tetrasporangia are also scattered.

The alga was collected in Redfish Bay during February to July. Vegetative specimens only were observed. Frequent.

Order Ceramiales

Family Ceramiaceae

*Callithamnion byssoides* (Figs. 164–168)

The alga forms pinkish-red tufts up to 1 cm long, composed of pinnately branched, unseriate filaments. Each cell of the main axis bears a branchlet and successive branchlets are arranged alternately. Cortication is absent. The sexual plants are dioecious. The antheridia consist of a system of short, compact filaments, borne on the upper surfaces of the branchlets. The female reproductive organ, the carpogonium, which bears a conspicuous trichogyne, is produced on

the main axis close to the apex of the filament. The paired carposporophytes are borne laterally on the main axis. The tetrahedrally divided tetrasporangia are formed on the upper surface of the branchlets.

The plant occurred on rocks and as an epiphyte on larger algae in the sublittoral zone on the southwest jetty at Port Aransas. Maximum growth occurred during the warmer part of the year. Vegetative, male and tetrasporic specimens were collected. Frequent.

The life-history of an isolate of the species from Port Aransas was completed in culture (Edwards 1969b). The effects of light intensity, daylength and temperature on the growth and reproduction of the isolate in culture were also determined (Edwards, in press).

*Griffithsia tenuis* (Fig. 169)

The plant consists of irregularly branched, uniseriate filaments composed of elongated, cylindrical cells. The cells in the younger portions are barrel-shaped and bear whorls of colorless branches or trichoblasts. The sexual plants are dioecious. The antheridia are produced at the apex of one- to three-celled branchlets. The carposporophyte, which is formed on a unicellular stalk, is surrounded by vegetative filaments. The tetrahedrally divided tetrasporangia are produced in a whorl on unicellular stalks at the nodes.

A tetrasporic specimen was found as an epiphyte on *Thalassia testudinum* in Redfish Bay. Rare.

*Spermothamnion* sp. (Figs. 170, 171)

The alga forms bright-red tufts up to 5 cm long composed of uniseriate, irregularly branched filaments approximately 100 $\mu$ diameter. The cells are elongated and cylindrical throughout the plant. The alga is reportedly monoecious. The antheridia are formed on short branchlets and are usually enclosed by vegetative filaments. The tetrahedrally divided tetrasporangia are also usually formed on short branchlets.

The alga was present on rocks and as an epiphyte on larger algae in the sublittoral zone on the southwest jetty at Port Aransas. Maximum growth occurred during the warmer months of the year. A specific determination of the alga could not be made since vegetative specimens only were observed. Frequent.

*Ceramium* (Figs. 172–178)

The plants in the genus are composed of tufts of dichotomously branched, uniseriate filaments which have distinctive, pincer-like apices. The cells of the axes are corticated at the nodes by a zone of smaller cells, whose arrangement is important for specific determinations within the genus. The species are mainly dioecious. The antheridia consist of a layer of minute, colorless cells on the corticated portions of the filament. The carpogonia and the carposporophytes are produced at the nodes; the latter comprise large, swollen, spherical bodies which may be lobed and are sometimes surrounded by vegetative filaments. The tetraspor-

angia are tetrahedrally divided and are also formed at the nodes, singly or in a whorl.

A good account of the genus was presented by Dixon (1960). West and Norris (1966) showed that *C. gardneri* from Puget Sound, Washington, has an isomorphic diplobiontic life-history in culture.

## KEY TO THE SPECIES

1. Corticating cells with two transverse cell rows ..... *C. fastigiatum* f. *flaccida*
1. Corticating cells with more than two cell rows ..... 2
    2. Lower one to two cells of the node distinctly broader than long ..... *C. byssoideum*
    2. Lower one to two cells of the node not broader than long ..... *C. strictum*

*C. byssoideum* (Figs. 173, 174)

The plants occur in reddish tufts up to 2.5 cm long. The corticating cells are arranged in several rows with a series of transversely elongated cells occurring in the lower portion of each band. One or two tetrasporangia are at the nodes.

The alga was found as an epiphyte on sea grasses and larger algae in the eulittoral zone on the southwest jetty at Port Aransas and in Redfish Bay during the summer and fall. Vegetative and tetrasporic specimens were observed. Rare.

*C. fastigiatum* f. *flaccida* (Figs. 172, 175)

The alga forms bright-red tufts up to 2.5 cm long. The nodal cells are arranged in two transverse rows in which the cells in the upper row are usually smaller than those in the lower. The tetrasporangia strongly project from the nodes.

The plants occurred on rocks and epiphytically on larger algae in the eulittoral zone on the southwest jetty at Port Aransas and in Aransas Bay. Maximum development occurred during the summer and fall. Vegetative and tetrasporic specimens were collected. Common.

*C. strictum* (Figs. 176–178)

The alga forms purplish-red tufts up to 2.5 cm long. The nodes are composed of several rows of cells and are readily visible to the naked eye. The tetrasporangia are immersed at the nodes and are arranged in a single whorl per segment.

The species occurred on rocks and as an epiphyte on larger algae in the eulittoral zone on the southwest jetty at Port Aransas. Maximum development took place in the warmer part of the year. Vegetative, carposporic and tetrasporic specimens were collected. Common.

*Centroceras clavulatum* (Figs. 179–182)

The plant consists of reddish-purple tufts up to 8 cm long. The filaments are dichotomously branched with pincer-like apices as in *Ceramium*, but the uniseriate axes are completely corticated by regular, longitudinal rows of rectangular cells. The nodes often bear short, colorless spines one to three cells long. Lateral, adventitious branchlets are often present on the main axes. The sexual plants are dioecious. The antheridia are borne on special branched, uniseriate

filaments. The carposporophytes are produced laterally on the axes and are partially surrounded by vegetative filaments. The tetrahedrally divided tetrasporangia are produced in whorls on special lateral branchlets.

The alga occurred in the eulittoral zone on the southwest jetty at Port Aransas and in Redfish Bay. Maximum development took place during the warmer part of the year. Vegetative and tetrasporic specimens were collected during the study. The author is grateful to T. Mumford for making available carposporic specimens which he collected on the southwest jetty at Port Aransas.

*Spyridia* (Figs. 183–185)

The plants consist of branched axes composed of uniseriate filaments of large cells which are completely covered with a small-celled cortex of longitudinally elongated cells. Rhizoidal outgrowths develop from the cortical cells on the older axes. The main axes are beset with radially arranged hair-like, determinate branchlets composed of a single row of cells with one to two rows of cortical cells encircling the nodes. The branchlets are terminated by a spine. The antheridia form patches on the nodes of the branchlets. The carposporophytes are produced terminally on short, lateral branches and are lobed. The tetrahedrally divided tetrasporangia occur singly in groups at the nodes of the branchlets.

## KEY TO THE SPECIES

1. Without pronounced main axes ..... *S. filamentosa*
1. With pronounced main axes ..... *S. aculeata*

*S. aculeata* (Figs. 183, 185)

The plant is up to 5 cm long and dark-red. The alga has distinct main axes and is more robust than the following species. One to two recurved spines are often present on the first two nodes, but these were not observed in the specimens from the area.

The alga was collected in the eulittoral zone on the southwest jetty at Port Aransas during the summer and fall. Vegetative and tetrasporic specimens were observed. Frequent.

*S. filamentosa* (Fig. 184)

The alga is up to 30 cm long and is pale red but often becomes bleached. The species does not have pronounced main axes and collapses when removed from the water.

The plant was present in Redfish Bay during the warmer months. Vegetative specimens only were collected. Common.

Family Rhodomelaceae

*Polysiphonia* (Figs. 186–200)

The genus contains plants composed of branched axes which are attached to the substratum by colorless rhizoids. The prominent apical cell terminating each

axis forms a uniseriate series of axial cells, each surrounded by four to eight pericentral cells. The pericentral cells and the central axial cell of each segment are of equal length; thus the axis is said to be polysiphonous. The main axes of some species are corticated by rhizoidal filaments produced by the pericentral cells. Two main kinds of branches are present, polysiphonous ones and trichoblasts. The former are of unlimited growth and resemble the main axes, but in certain species additional short, spine-like branches of limited growth are developed on the main axes. The trichoblasts consist of colorless, branched, uniseriate hairs which are often deciduous. The sexual plants are dioecious. The antheridia are borne on modified trichoblast filaments. The carpogonia often have rather distinct, persistent trichogynes. The cystocarps are large and urn-shaped with a distinct envelope, the pericarp, surrounding the carposporophyte; the cystocarp opens through an apical pore.

Plants of this genus may be readily recognized, but specific determinations are often difficult. The main taxonomic criteria employed in the delimitation of the species are the number of pericentral cells per segment and the origin of the polysiphonous branches in relation to the trichoblasts. The determination of the number of pericentral cells is facilitated by placing a portion of the alga in 50% (approximately 5 N) hydrochloric acid on a slide; the cells separate readily when slight pressure is applied to the cover slip with a blunt instrument (W. R. Taylor, personal communication). The polysiphonous branches and trichoblasts are homologous structures with regard to their origin. The entire branch primordium becomes a branch in certain species and produces either a polysiphonous branch or a trichoblast. The branch primordium divides in other species, the outer portion giving rise to a trichoblast and the inner to a polysiphonous branch. Hence, the polysiphonous branches are said to arise independently of the trichoblasts in the former instance and to arise in the axils of the trichoblasts in the latter. It is generally necessary to search close to the apex of the axis to determine the relationship between the polysiphonous branches and the trichoblasts.

A morphological account of the genus is given by Hollenberg (1942).

## KEY TO THE SPECIES

1. Pericentral cells four ..... 2
1. Pericentral cells usually six ..... 3
1. Pericentral cells usually eight ..... *Polysiphonia tepida*
    2. Plants up to 3 cm long; epiphytic on *Diplanthera wrightii* ..... *P. gorgoniae*
    2. Plants usually much longer than 3 cm and not epiphytic on *Diplanthera wrightii* ... 4
3. Branches arising in axils of trichoblasts ..... *P. denudata*
3. Branches arising independently of trichoblasts ..... *P. boldii*
    4. Main axes covered with short, spine-like branches ..... *P. echinata*
    4. Main axes not covered with short, spine-like branches ..... 5
5. Branches arising in axils of trichoblasts ..... *P. havanensis*
5. Branches arising independently of trichoblasts ..... *P. subtilissima*

### *P. boldii* (Figs. 186, 197, 198)

The species is reddish-brown to almost black and is up to 2 cm long. The alga has well-developed prostrate and erect axes. The branches arise indepen-

dently of the trichoblasts. The main axes are up to 100 to 130 $\mu$ in diameter and the segments have a maximum length of half to one diameter. Six pericentral cells (occasionally seven) are present. The antheridia are distinct in this species in that each antheridial branch has two arms which bear antheridia and not one as in the majority of the species.

The alga occurred in Aransas and Redfish Bays and occasionally on the southwest jetty at Port Aransas, usually attached to oyster shells, rock and wood, and was present throughout the year. Vegetative, male, female, carposporic and tetrasporic specimens were collected. Common.

The life-history of the species was determined in culture but erroneously reported as *P. denudata* (Edwards 1968). The effects of variations in light intensity, daylength and temperature on the growth and reproduction of the alga in culture were determined (Edwards 1969a). The species was discovered during the study (Wynne and Edwards, 1970).

*P. denudata* (Figs. 187, 196, 199, 200)

The plant is reddish in the distal branches, but the lower portions of the thallus are often brownish. The alga is up to 4 cm long and prostrate axes are poorly developed or absent. The polysiphonous branches arise in the axils of the trichoblasts. The main axes are up to 350 to 400 $\mu$ in diameter and the segments have a maximum length of one to two diameters. Six pericentral cells (occasionally seven) are present. The antheridial branches occur singly with trichoblasts.

The alga was present in the sublittoral zone on the southwest jetty at Port Aransas throughout the year. Vegetative, male, female, carposporic and tetrasporic specimens were collected. Common.

The life-history of the species was completed in culture; the effects of light intensity, daylength and temperature variations on growth and reproduction of the species were ascertained (Edwards, in press). The species did not hybridize in culture with the preceding one (Edwards 1970).

*P. echinata* (Figs. 188, 194)

The plants are dark brown, up to 6 cm long, stiff and robust. The polysiphonous branches arise in the axils of the trichoblasts. The main axes are covered with spine-like branches about 1 mm long. The main axes are up to 400 to 600 $\mu$ in diameter and the segments have a maximum length of one-half to one diameter. Some cortication is present at the bases of the older axes. Four pericentral cells are present. The antheridial branches occur singly with trichoblasts.

The alga was present in Redfish Bay during early spring. It was drifting, attached to oyster shells or epiphytic on larger algae. Vegetative and tetrasporic specimens were collected. Frequent.

The life-history of the species was determined in culture and shown to be of the isomorphic diplobiontic type.

*P. gorgoniae* (Fig. 189)

The plants are light-brown and up to 3 cm long. Prostrate axes are poorly

developed or absent. The polysiphonous branches arise in the axils of the trichoblasts. A few short, spine-like branches are generally present. The main axes are up to 250 $\mu$ in diameter and the segments have a maximum length of one to two diameters. Four pericentral cells are present. The antheridial branches occur singly with trichoblasts.

The alga occurred epiphytically on *Diplanthera wrightii* in Redfish Bay during the warmer months of the year. Vegetative, male, female, carposporic and tetrasporic specimens were collected. Common.

The life-history of the species was determined in culture and was shown to be of the isomorphic diplobiontic type.

*P. havanensis* (Fig. 190)

The plants are reddish-brown, up to 9 cm long and soft in texture. The polysiphonous branches arise in the axils of the trichoblasts. The main axes are up to 250 to 300 $\mu$ in diameter and the segments have a maximum length of two to four diameters. Four pericentral cells are present. The antheridial branches occur singly with trichoblasts.

The alga was collected in late winter and spring from Aransas Bay. Vegetative, female, carposporic and tetrasporic specimens were collected. Frequent.

Tetraspores developed into male or female plants in culture, before the isolate was discarded because of contamination.

*P. subtilissima* (Fig. 191)

The alga is blackish-purple, up to 6 cm long and very soft in texture. The polysiphonous branches arise independently of the trichoblasts. The main axes are up to 100 $\mu$ in diameter and the segments have a maximum length of two to four (occasionally up to eight) diameters. Four pericentral cells are present.

The species was found throughout the year in Aransas Bay. The plants were largely vegetative but tetrasporic specimens were occasionally collected. Common.

*P. tepida* (Figs. 192, 193, 195)

The plant is bright-red and up to 2 cm long. The branches arise in the axils of the trichoblasts. The main axes are up to 100 $\mu$ in diameter and the segments have a maximum length of two to three diameters. Eight perientral cells (occasionally seven) are present. Common.

The species was observed in the eulittoral zone on the southwest jetty at Port Aransas and in Aransas Bay during the warmer part of the year. Vegetative specimens only were collected. Common.

*Bryocladia* (Figs. 201–206)

The plants are simple or branched and have ecorticate, polysiphonous axes with several pericentral cells. The lateral branchlets are distinctly shorter than the lesser branches and are radially arranged. Colorless, branched trichoblasts are often present towards the apices of the branchlets. The antheridia are borne on modified trichoblast filaments near the apices of the branchlets. The cystocarps

are large and urn-shaped and are borne on the branchlets. The tetrahedrally divided tetrasporangia are arranged in the upper segments of the branchlets.

## KEY TO THE SPECIES

1. Axes simple to sparingly branched; branchlets densely arranged on the axis .... *B. cuspidata*
1. Axes abundantly branched ..... *B. thyrsigera*

*B. cuspidata* (Figs. 201–204)

The plants are brown and have erect, simple to sparingly branched main axes up to 8 cm long. The short, stiff, lateral branchlets, up to 2 mm long, are densely arranged on the main axis in a spiral.

The species was present in the eulittoral zone on the southwest jetty at Port Aransas throughout the year, although it was best developed during summer and fall. Vegetative, male, carposporic and tetrasporic specimens were observed. Common.

*B. thyrsigera* (Figs. 205, 206)

The plants are dark reddish-brown when alive, but turn black when dried and do not adhere well to paper. The alga is up to 5 cm long and abundantly branched. The lateral branchlets are short and disposed on the axes in a spiral, as in the preceding species, but are not as densely arranged.

The alga was collected in the eulittoral zone on the southwest jetty at Port Aransas in summer. Carposporic specimens were observed. Rare.

*Digenia simplex* (Figs. 207–209)

The alga is brownish-red, up to 21 cm long and has a stiff texture. The main axes do not have a visible polysiphonous structure, but have a colorless, large-celled medulla to the inside and a pigmented, small-celled cortex to the outside. The main axes are beset with radially arranged, short, lateral branchlets. The latter have six to eight pericentral cells covered by a thin cortex, with colorless trichoblasts at their apices. The antheridia are produced in ovoid discs at the apices of the branchlets. The cystocarps are borne on the branchlets. The tetrahedrally divided tetrasporangia are formed in the distal parts of the branchlets.

The plant was found attached to oyster shells or drifting in Aransas and Redfish Bays. Vegetative and male specimens were collected. The species was present throughout the year but demonstrated maximum growth during the warmer months. Common.

*Herposiphonia tenella* (Fig. 210)

The plants are deep reddish-brown and form small creeping mats up to 2 cm tall. The apices of the prostrate axes are generally inrolled away from the substratum. The prostrate axes give rise to erect axes of both unlimited and limited growth, the latter being unbranched. The axes have a central axial filament surrounded by a circle of several pericentral cells. Colorless trichoblasts are present at the apices of the branches. The reproductive organs are similar to

those of *Polysiphonia* and are borne at the apices of the erect branches of limited growth.

The alga was collected on rocks and as an epiphyte on larger algae in the sublittoral zone on the southwest jetty at Port Aransas. Maximum development occurred in the summer. Vegetative and tetrasporic plants were collected. Frequent.

The author followed Hollenberg (1968) who considered *H. secunda* to be conspecific with *H. tenella.*

*Chondria* (Figs. 211–218)

The plants in the genus consist of terete branched axes which bear lateral, spindle- or club-shaped branchlets in which the apical cell is exposed or sunken in a depression. The branchlets are tipped by a cluster of trichoblasts. A central axial filament surrounded by five pericentral cells is evident in the center of the axis; these are, in turn, surrounded by several layers of generally smaller cells and ultimately by a cortex of still smaller, pigmented cells. The sexual plants are dioecious. The antheridia are borne on flat plates near the apices of the branchlets. The cystocarps are prominent on the ultimate branchlets. The tetrahedrally divided tetrasporangia are situated among the cortical cells of the lateral branchlets. The species in the genus are notoriously polymorphic and consequently difficult to identify.

KEY TO THE SPECIES

1. Branchlets markedly more slender than the main axes; tips of the branchlets acute ..... *C. littoralis*
1. Branchlets intergrading in size gradually with the main axes; tips of the branchlets obtuse ..... 2
   2. Thallus with a pyramidal outline; strongly staining the paper brown upon drying ..... *C. dasyphylla*
   2. Thallus with a sprawling habit; not strongly staining the paper brown upon drying ..... *C. cnicophylla*

*C. cnicophylla* (Fig. 211)

The alga is up to 25 cm long, brownish and does not strongly stain the paper brown upon drying. The plant has a sprawling habit with the axes branching almost at right angles. The branchlets intergrade in size gradually with the main axes. The branchlets are contracted at the base and have blunt apices. The terminal apical cells are sometimes visible.

The plant was found drifting in Redfish Bay from November to June. Vegetative, male, carposporic and tetrasporic specimens were collected. Common.

*C. dasyphylla* (Figs. 212, 214, 216)

The alga is up to 3.5 cm long and pale brown. The species stains the paper brown when pressed. The plant has a pyramidal outline and there is a regular gradation in size between the main axes and the branchlets. The latter are club-shaped with truncate tips. The apical cell does not project from the apex.

The plant was collected from the eulittoral zone on the southwest jetty at Port Aransas. The specimens were vegetative. Rare. The identification of the specimens is tentative.

*C. littoralis* (Figs. 213, 215, 217, 218)

The alga is up to 16 cm long and light-brown to brownish-purple. The species may be readily recognized, since the branchlets are markedly more slender than the main axes. The tips of the branchlets are acute with prominent terminal apical cells.

The species was found attached to oysters, rocks and wooden pilings in Aransas Bay throughout the year. Vegetative, male, carposporic and tetrasporic specimens were observed. Common.

*Laurencia poitei* (Figs. 219, 220)

The plant varies from reddish to green and is up to 20 cm long. The terete axes are irregularly branched, stiff and bear lateral, peg-like branchlets which are very short and not basally constricted. A central axial filament surrounded by pericentral cells may be recognized in the early stages of development but the adult axis consists of a medulla of large, colorless cells covered by a cortex of smaller pigmented cells. The apical cell of each axis is sunk in a depression at the apex of the branch and is surrounded by trichoblasts. The antheridia are borne on branched trichoblasts in apical depressions in the fertile branchlets. The cystocarps are prominent and scattered over the lateral branchlets. The tetrahedrally divided tetrasporangia are scattered among the cortical cells of ultimate branchlets.

The alga was found drifting in Redfish Bay throughout the year but was best developed during the warmer part of the year. Vegetative specimens only were observed. Common.

## MARINE FLOWERING PLANTS

The majority of marine plants are algae but five species of flowering plants, commonly called "sea grasses", were observed in the study area. The sea grasses form extensive beds or flats in Aransas and Redfish Bays.

The plants generally consist of a creeping, branched, underground rhizome which produces erect shoots and roots. The erect shoot consists of a very short, basal stalk which bears the leaves. The local species lose their leaves in winter and perennate by their rhizomes. Reproduction takes place sexually by the production of staminate and pistillate flowers followed by seed formation or vegetatively by the production of new shoots on the elongating rhizome.

The sea grasses form excellent substrata for epiphytic algae and are often densely covered by them. Humm (1964) recorded 113 species of algae which grew epiphytically on *Thalassia testudinum* in Florida. Humm (1956) and Phillips (1960) gave accounts of the sea grasses in the Gulf of Mexico. The

salinity tolerances of the sea grasses from Redfish Bay were investigated experimentally by McMillan and Moseley (1967).

Order Hydrocharitales

Family Hydrocharitaceae

*Halophila engelmannii* (Fig. 221)

The species is very distinctive because of its elliptical leaves which are arranged in a rosette at the tip of the short stem. The leaves have a faint central vein. Sexual reproduction is rare and propagation proceeds largely by vegetative means.

The plant was found in the deeper waters of Redfish Bay during the warmer months of the year. Frequent.

*Thalassia testudinum* (Turtle Grass) (Fig. 222)

The plant may be distinguished from the other species by its broad, strap-shaped leaves, 5 to 10 mm wide. Flowering is rare and reproduction takes place vegetatively.

The species was observed in the shallower waters of Aransas and Redfish Bays during the warmer part of the year. Common.

Order Najadales

Family Potamogetonaceae

*Cymodocea filiforme* (Manatee grass) (Fig. 223)

The plant may be recognized readily by its long, terete leaves with blunt apices. It superficially resembles the aerial portion of an onion. Sexual reproduction is rare and vegetative growth constitutes the major means of reproduction.

The species occurred in the deeper waters of Redfish Bay. It is reportedly present throughout the year, in contrast to the other species in the area which grow only during the warmer months. Frequent.

*Diplanthera wrightii* (Shoal grass) (Fig. 224)

The plant has narrow, flat leaves 1.5 to 2 mm wide which are distinctly truncate and toothed at the apex. Flowering is rare and reproduction is largely by vegetative means.

The species was observed in the shallower waters of Aransas and Redfish Bays during the warmer part of the year. Common.

*Ruppia maritima* (Widgeon grass) (Fig. 225)

The species differs from the other local sea grasses in that a stalk is absent; the leaves arise directly from the rather thin rhizome which is in part upright and above the substratum. The narrrow, flat leaves, 1 to 1.5 mm wide, have a pointed apex. Flowering is common and sexual reproduction appears to play as large a part in the propagation of the species as vegetative reproduction.

The plant was collected in the shallower waters of Aransas and Redfish Bays during the warmer months of the year. Common.

## ACKNOWLEDGMENTS

The author is indebted to Dr. H. C. Bold whose assistance and encouragement were instrumental in the completion of the guide. Dr. M. J. Wynne kindly offered helpful suggestions and critically read the manuscript. The staff of the University of Texas Marine Science Institute at Port Aransas, in particular Drs. B. J. Copeland, W. Behrens and C. Van Baalen, were very generous in their hospitality to the writer during field trips to the study area. The aid of the following people in identifying specimens is gratefully acknowledged: Drs. P. S. Dixon, S. A. Earle, C. van den Hoek, G. J. Hollenberg, H. J. Humm, W. J. Johansen, W. R. Taylor and M. J. Wynne. Dr. D. F. Kapraun kindly provided the data upon which the section on the Ulvales is largely based. The writer and his research were supported in part by NSF Grant GB 6914 to the University of Texas and in part by NSF Grant GB 7987X and the U. S. Department of Interior Grant WP-18050 and 16010 DBR to Dr. H. C. Bold.

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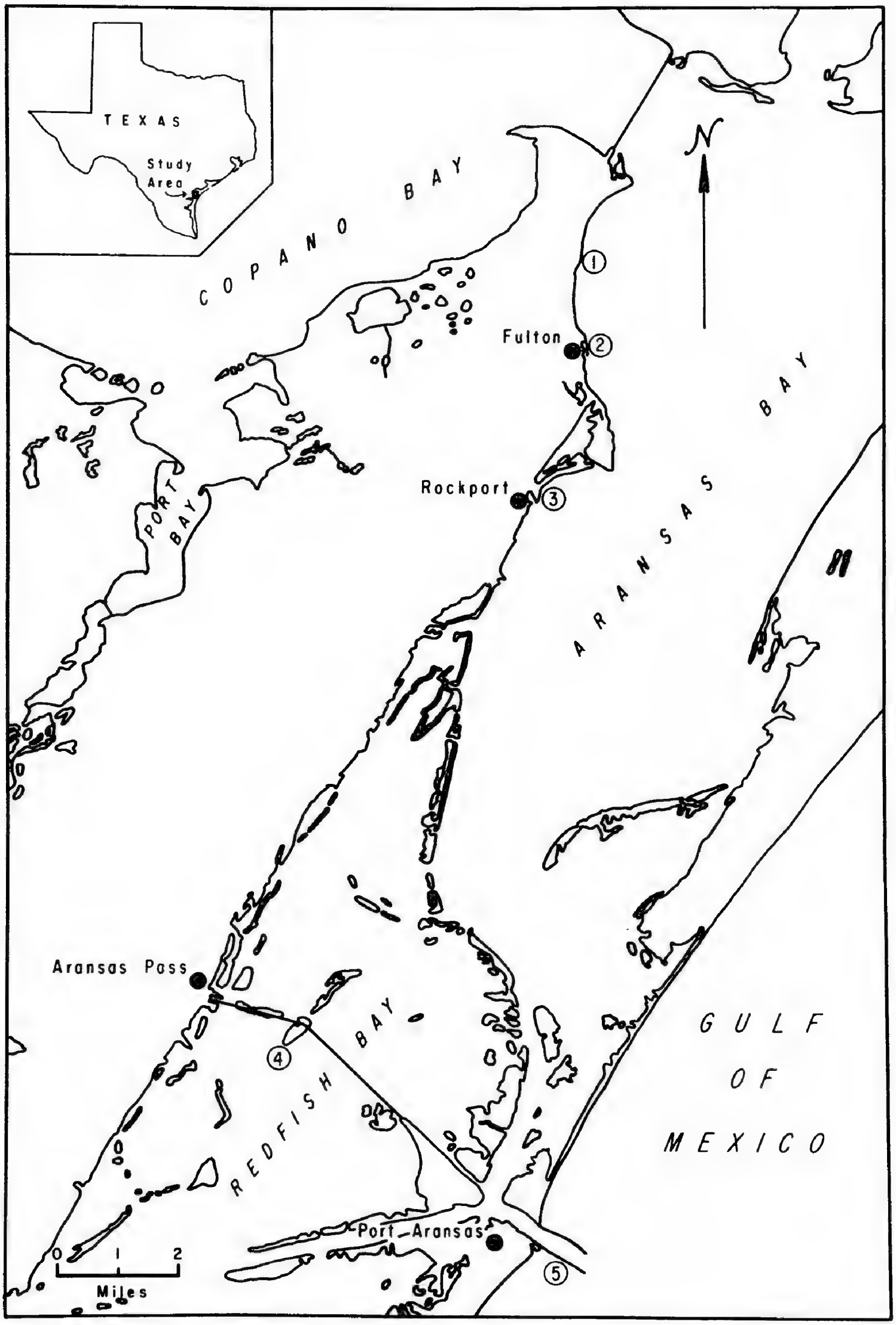
# Illustrations

FIG. 1. Map of the study area. The numbers refer to stations at which monthly collections of algae were made. Station 1, Fulton beach; Station 2, Fulton harbor; Station 3, Rockport; Station 4, grass flats and oyster reef, Redfish Bay; Station 5, the southwest jetty at Port Aransas. Modified from U.S. C. and G. S. Map. No. 1285.


TEXAS
Study Area
COPANO BAY
Fulton
Rockport
PORT BAY
ARANSAS BAY
Aransas Pass
REDFISH BAY
Port Aransas
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FIGS. 2–9. The types of habitats from which seaweeds and sea grasses were collected.

FIG. 2. Fulton beach. Rocks, oyster shells and the wooden pilings of the fishing piers were colonized by algae.

FIG. 3. Fulton harbor. Algae were collected on the concrete outer wall of the harbor.

FIG. 4. Rockport. Algae were present on the oyster-covered concrete breakwater and on oyster shells at the shallow water's edge.

FIG. 5. Redfish Bay. The shallow regions of the bay are often colonized by dense stands of sea grasses.

FIG. 6. Redfish Bay. An oyster reef exposed at low tide.

FIG. 7. Port Aransas. A view from the end of the southwest jetty looking towards the shore.

FIG. 8. Port Aransas, on the southwest jetty. The rocks close to the water's edge are densely covered with algae.

FIG. 9. Port Aransas. Pools by the beach at the side of the southwest jetty contain rocks covered by members of the Ulvales.

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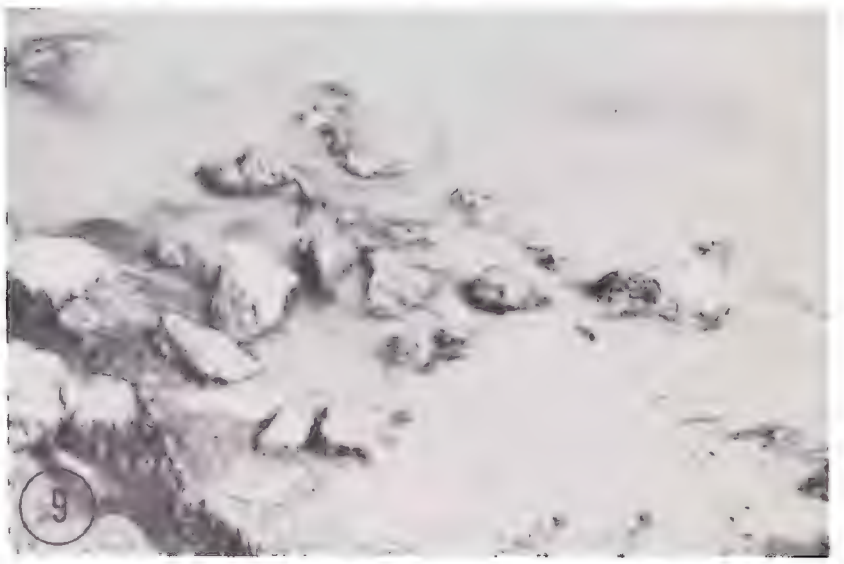
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FIGS. 10–18. Vertical and seasonal distributions of the local marine algae.

FIG. 10. The eulittoral zone on the southwest jetty at Port Aransas, during the summer, 1967.

FIG. 11. The littoral fringe at the end of the southwest jetty at Port Aransas, during the summer, 1967. The rock in the foreground was covered by *Enteromorpha clathrata*, the rocks in the background by *Ulva fasciata*.

FIG. 12. *Ulva fasciata*, *Cladophora vagabunda* and *Bryocladia cuspidata* in the eulittoral zone on the southwest jetty at Port Aransas during the summer, 1967.

FIG. 13. *Ulva fasciata* and *Centroceras clavulatum* in the eulittoral zone on the southwest jetty at Port Aransas during the summer, 1967.

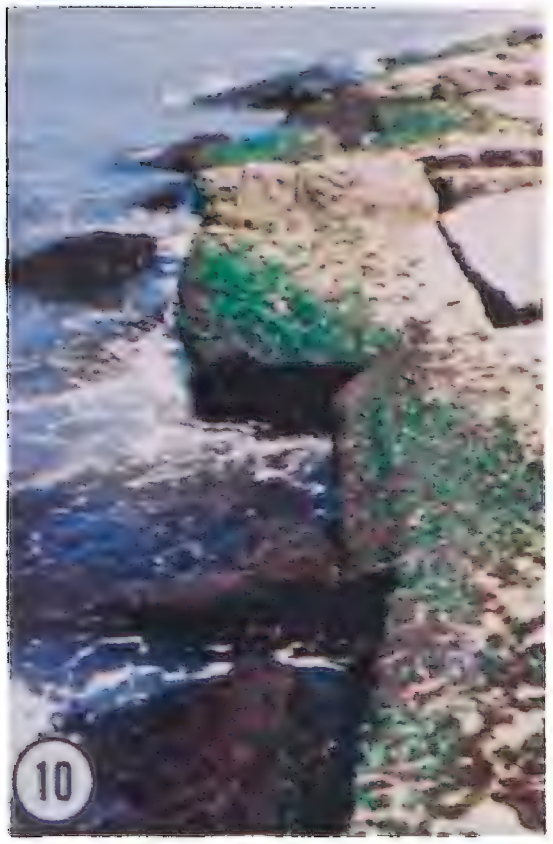
FIG. 14. The upper portion of the sublittoral zone on the southwest jetty at Port Aransas in the summer, 1967. The red alga *Agardhiella tenera* and the brown alga *Padina vickersiae* may be seen close to the water's edge.

FIG. 15. A series of very low tides caused a marked reduction in the eulittoral vegetation during September, 1968. Dead *Ulva fasciata* (bleached white) and *Hypea musciformis* (reddish but normally dark red-brown) may be seen.

FIG. 16. *Porphyra leucosticta* dominated the eulittoral zone on the southwest jetty at Port Aransas during the winter, 1968.

FIG. 17. The littoral fringe on the southwest jetty at Port Aransas was dominated by *Bangia fuscopurpurea* during the winter, 1967.

FIG. 18. *Enteromorpha clathrata* and *Ectocarpus siliculosus* in the shallow water of Port Bay (four miles from the study area) during the winter, 1968.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FIGURES 19–24[1]

FIG. 19. *Ulothrix flacca.* Detail of the filaments showing cell form and plastids (cultured material).

FIG. 20. *Entocladia viridis* epiphytic on *Cladophora vagabunda.* Detail of a filament showing cell form.

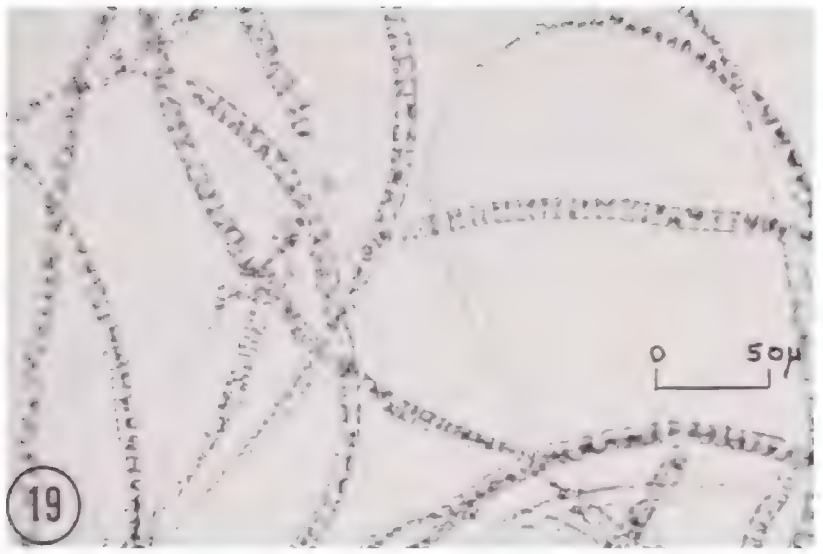
FIG. 21. *Ulvella lens* epiphytic on *Laurencia poitei.*

FIG. 22. *Enteromorpha ramulosa.*

FIG. 23. *Enteromorpha clathrata.*

FIG. 24. *Enteromorpha flexuosa.*

[1] The habit photograph of the plants were made from herbarium specimens unless otherwise indicated.

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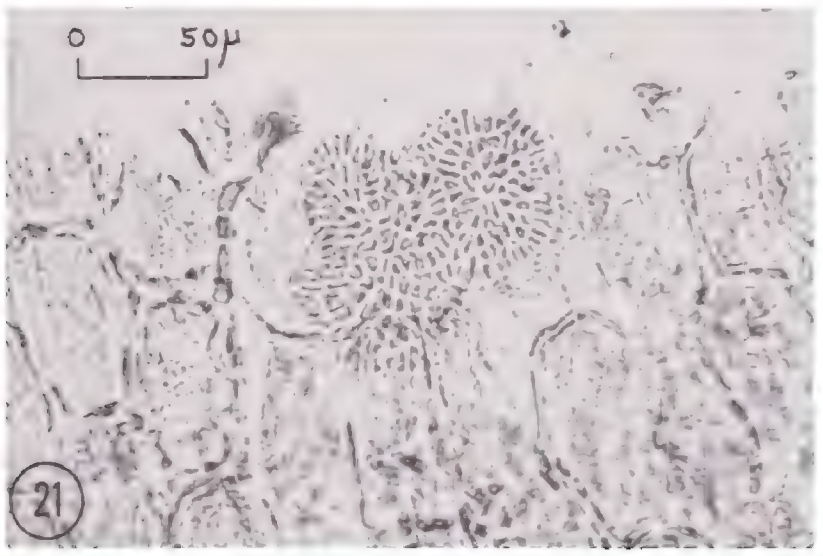


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FIGURES 25–29

FIG. 25. *Enteromorpha lingulata.*
FIG. 26. *Enteromorpha prolifera.*
FIG. 27. *Enteromorpha salina.*
FIG. 28. *Enteromorpha prolifera*; the cells are arranged in regular, longitudinal series in the younger parts of the thallus (cultured material).
FIG. 29. *Enteromorpha prolifera*; the cells are irregularly arranged in the older parts of the thallus (cultured material).

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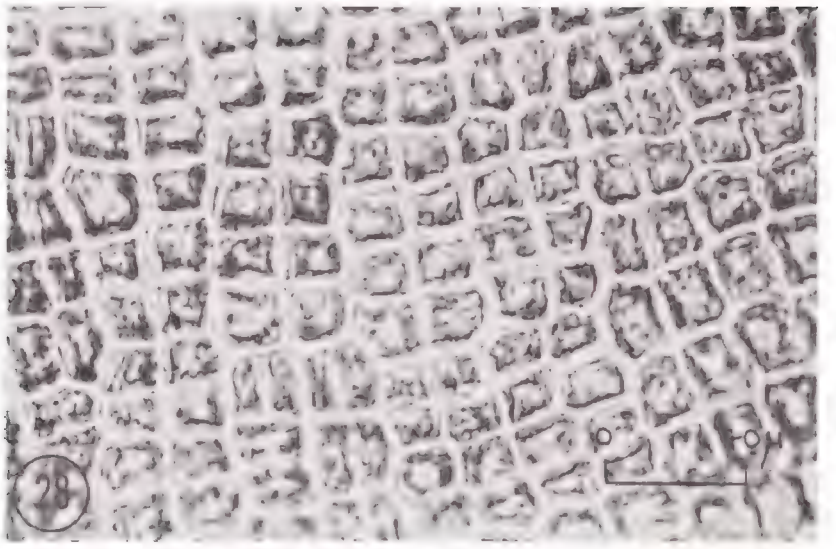
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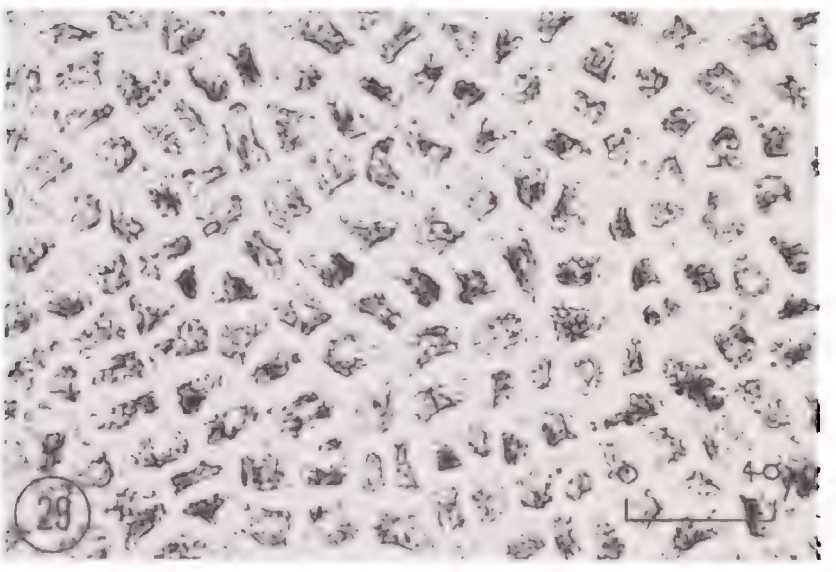
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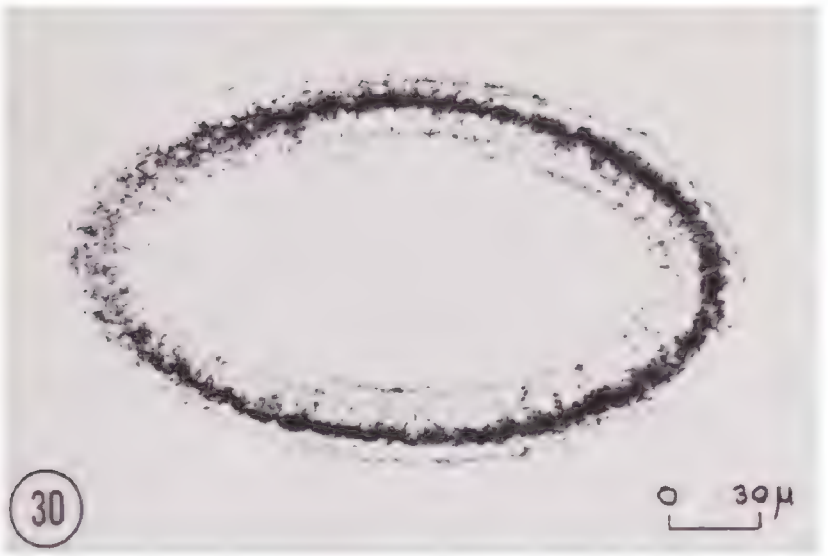
FIGURES 30–34

FIG. 30. *Enteromorpha salina*; a hand-cut transverse section of the thallus (cultured material).
FIG. 31. *Ulva lactuca*; a hand-cut transverse section of the thallus (herbarium material).
FIG. 32. *Ulva fasciata.*
FIG. 33. *Ulva lactuca.*
FIG. 34. *Chaetomorpha linum*; the attached form from the southwest jetty at Port Aransas.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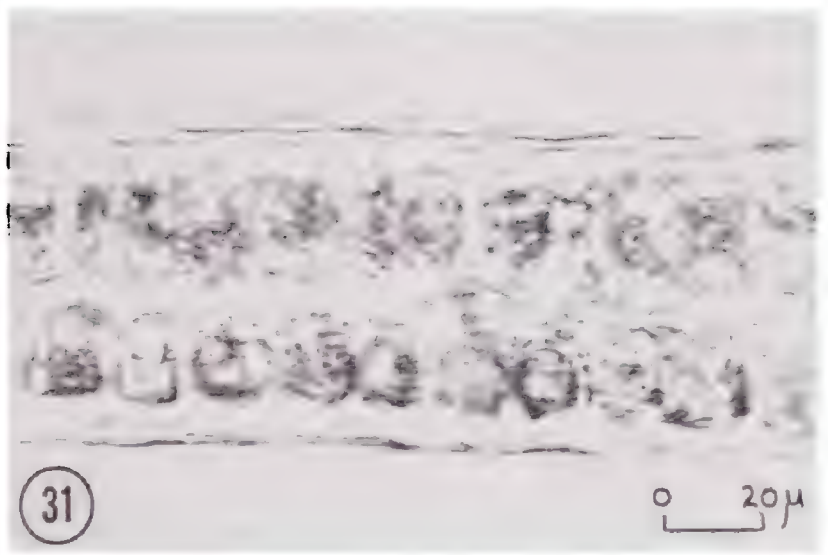
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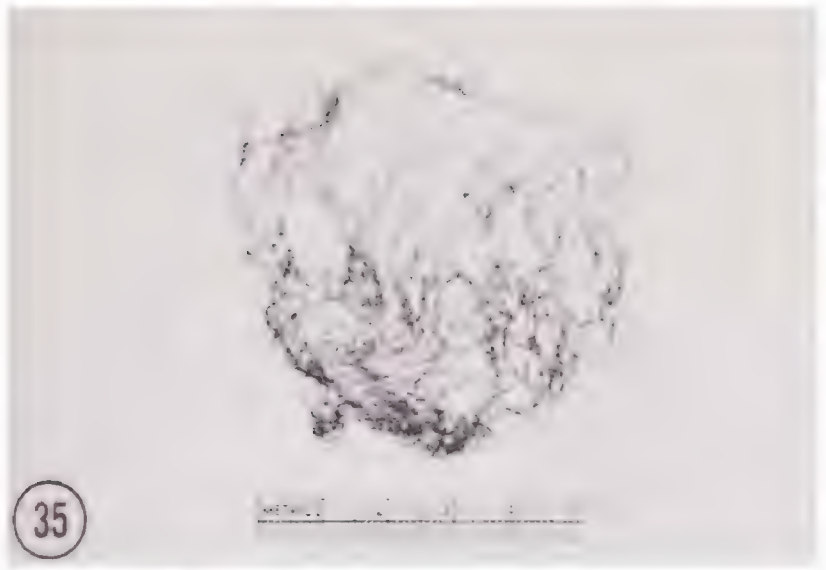
FIGURES 35–41

FIG. 35. *Chaetomorpha linum*; the free and entangled form from Redfish Bay.
FIG. 36. *Chaetomorpha linum*; detail of the filaments showing cell form (preserved material).
FIG. 37. *Chaetomorpha linum*; a base of a filament showing the modification of the basal cell as a holdfast (preserved material).
FIG. 38. *Chaetomorpha linum*; detail of a cell showing the reticulate plastid, containing pyrenoids (preserved material).
FIG. 39. *Cladophora albida.*
FIGS. 40, 41. *Cladophora dalmatica*; variations in habit.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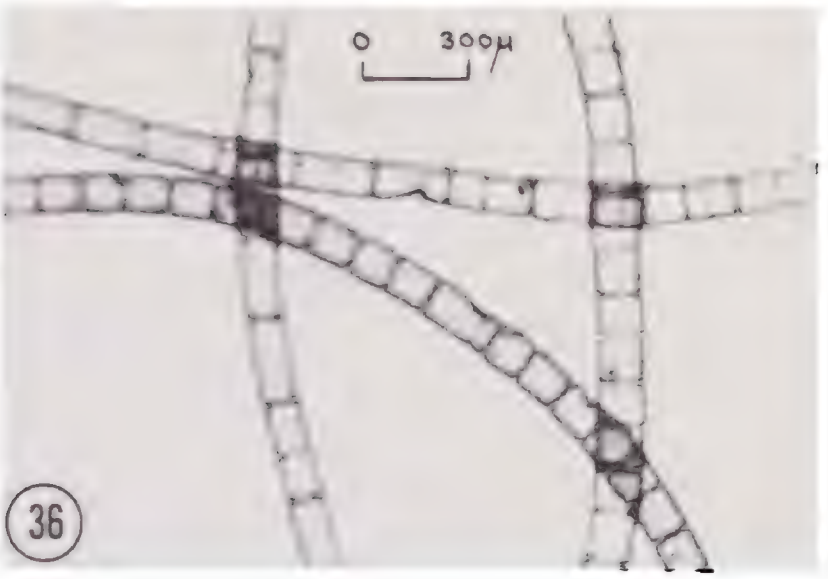
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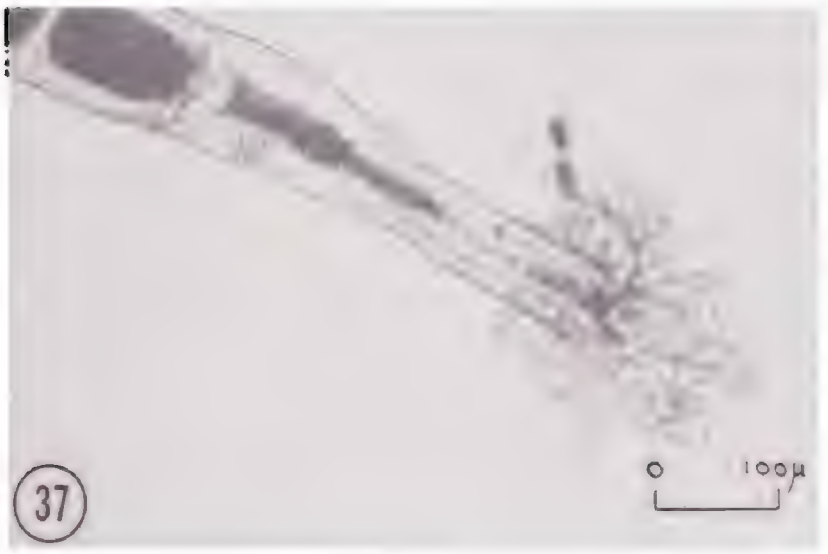
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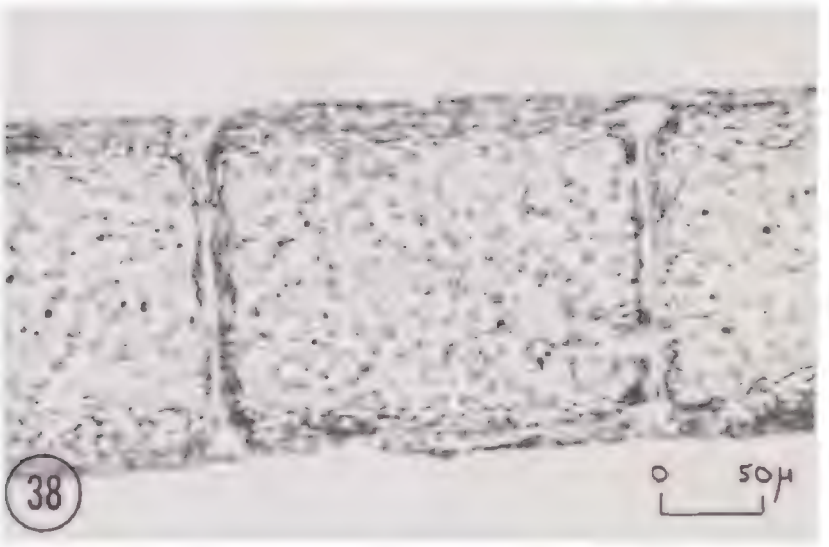
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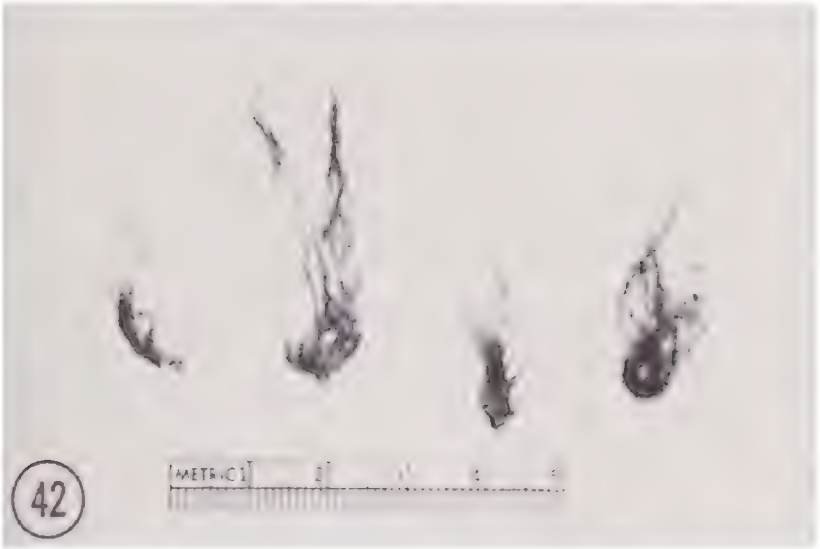
40

FIGURES 42–48

FIG. 42. *Cladophora delicatula.*
FIG. 43. *Cladophora ruchingeri.*
FIG. 44. *Cladophora vagabunda.*
FIG. 45. *Cladophora albida*; details of branching (preserved material).
FIG. 46. *Cladophora dalmatica*; details of branching (preserved material).
FIG. 47. *Cladophora ruchingeri*; details of branching (preserved material).
FIG. 48. *Cladophora vagabunda*; details of branching (preserved material).

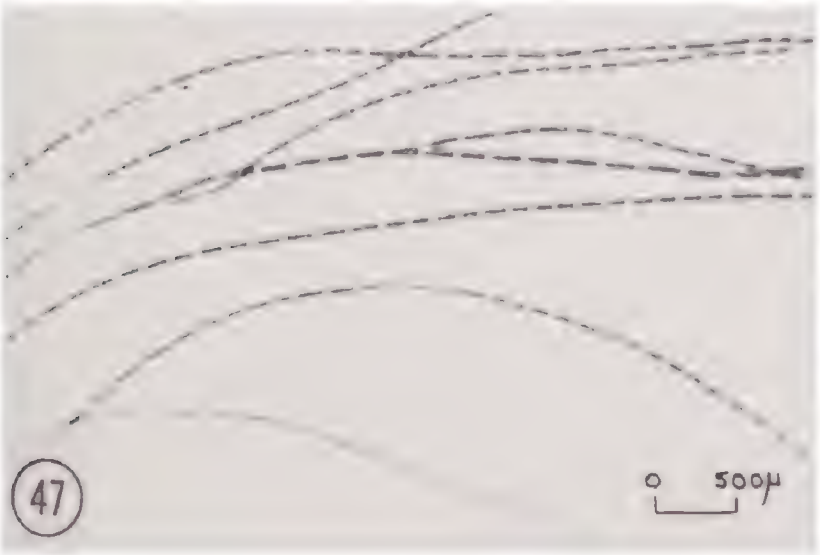

42
METRIC 1

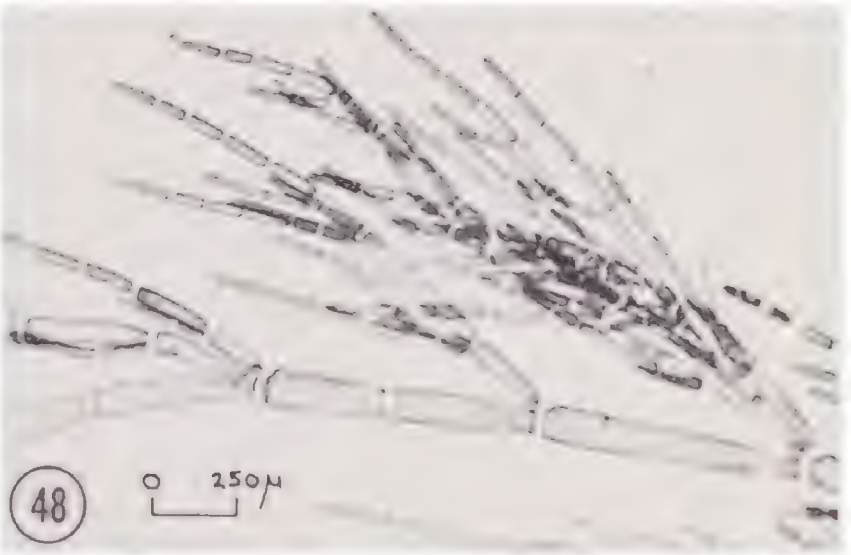
43

44
METRIC 1
2
3
4
5

45
0 500μ

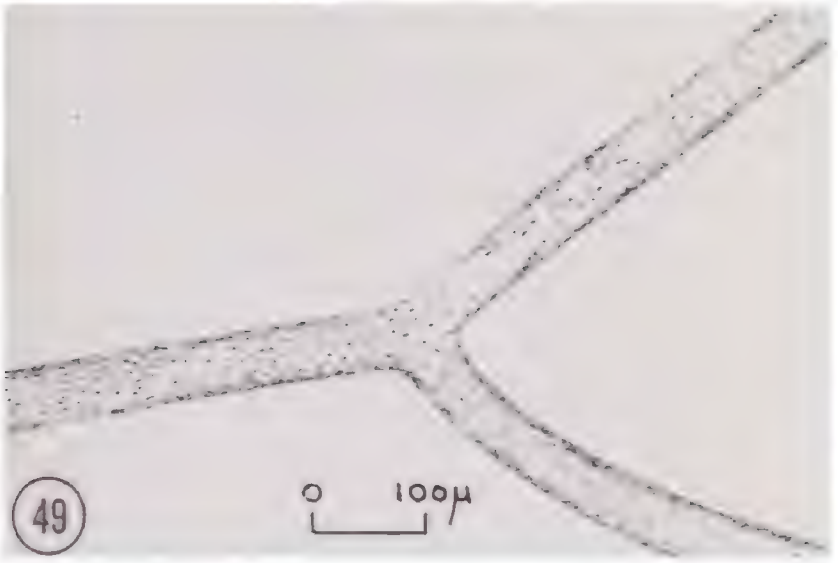
46
0 500μ

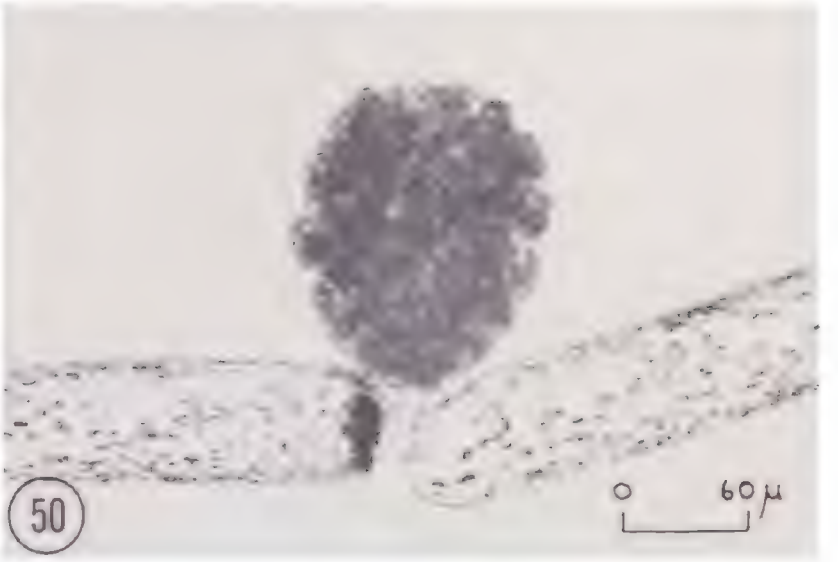

47
0 500μ

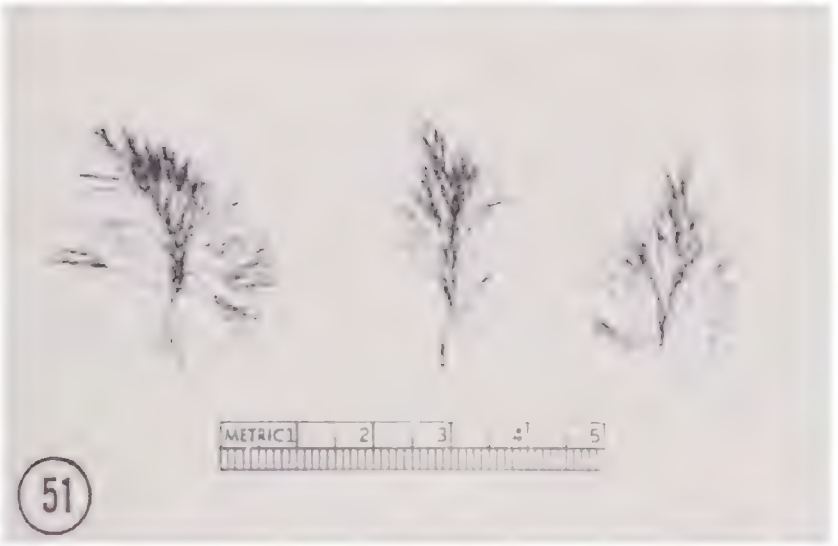

48
0 250μ

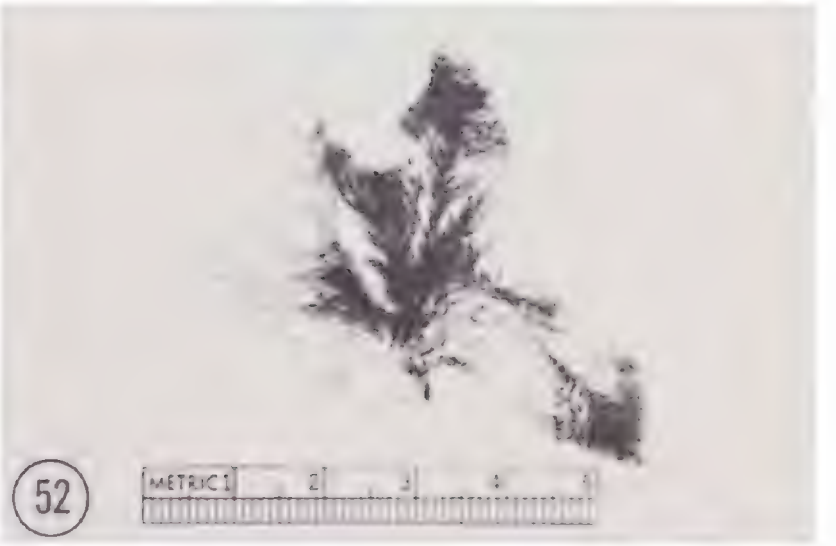
FIGURES 49–56

FIG. 49. *Derbesia vaucheriaeformis*; details of branching (living material from nature).
FIG. 50. *Derbesia vaucheriaeformis*; a reproductive organ (living material from nature).
FIGS. 51, 52. *Bryopsis hypnoides*; variations in the plant habit.
FIGS. 53, 54. *Bryopsis plumosa*; variations in the plant habit.
FIG. 55. *Bryopsis plumosa*; an apical portion of a frond showing the coenocytic nature of the thallus and the plastids (preserved material).
FIG. 56. *Acetabularia crenulata*.


49
0 100μ

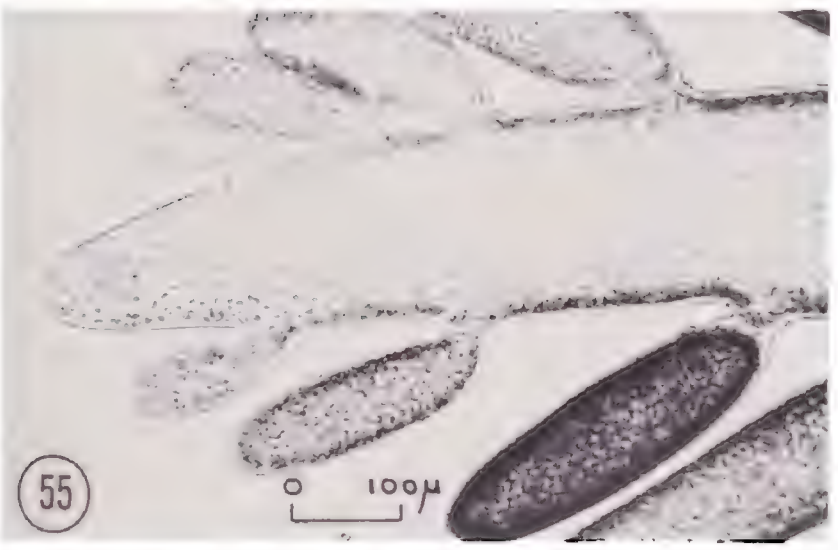

50
0 60μ


51
METRIC 1 2 3 4 5


52
METRIC 1 2 3 4 5

53

54

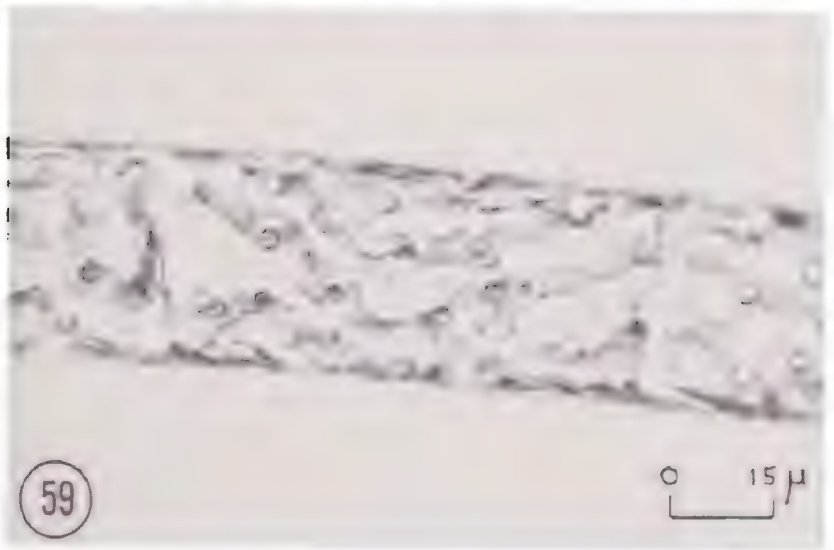

55
0 100μ

56

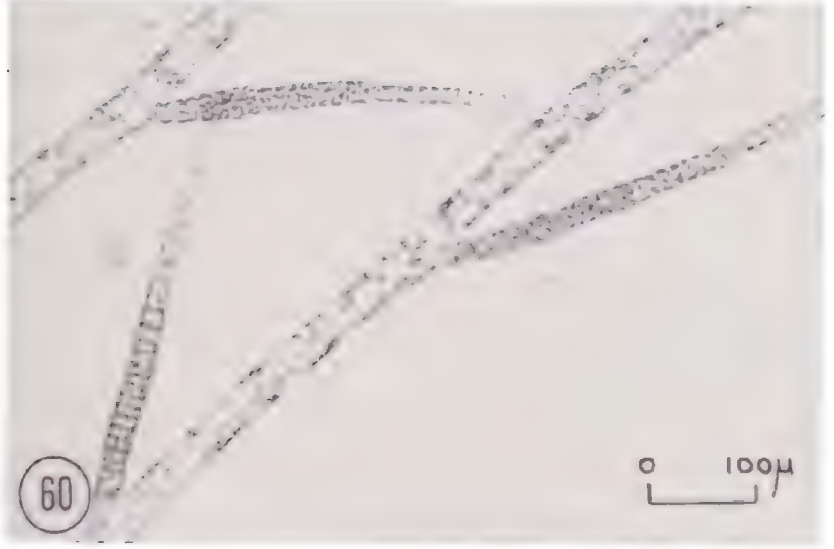
FIGURES 57–63

FIG. 57. *Acetabularia crenulata*; a portion of a disc showing the gametangial rays containing cysts (preserved material).
FIG. 58. *Ectocarpus siliculosus.*
FIG. 59. *Ectocarpus siliculosus*; detail of a cell showing the bandshaped plastids and pyrenoids (cultured material).
FIG. 60. *Ectocarpus siliculosus*; a "typical" plurilocular reproductive organs which are greatly elongated and terminated by colorless hairs (living material from nature).
FIG. 61. *Ectocarpus siliculosus*; shorter plurilocular reproductive organs without terminal hairs (living material from nature).
FIG. 62. *Giffordia indica.*
FIG. 63. *Giffordia mitchelliae.*

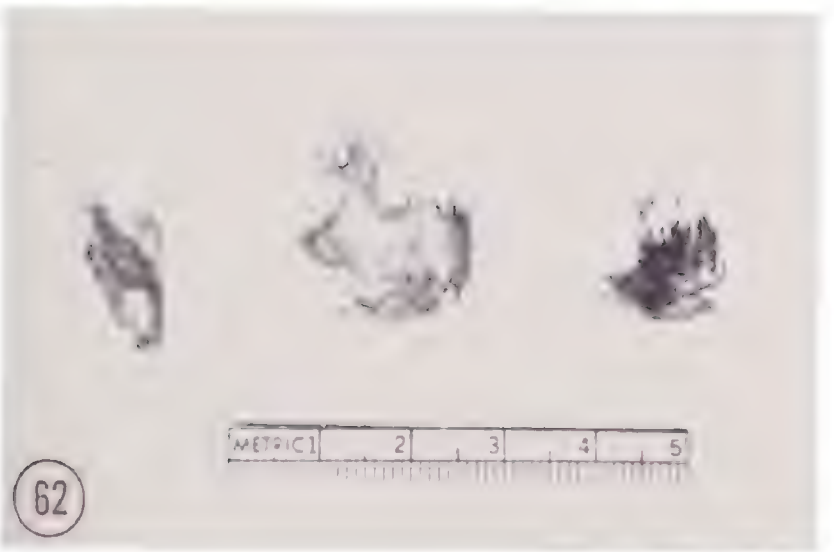
250μ
57


15μ
59

58


100μ
60

150μ
61

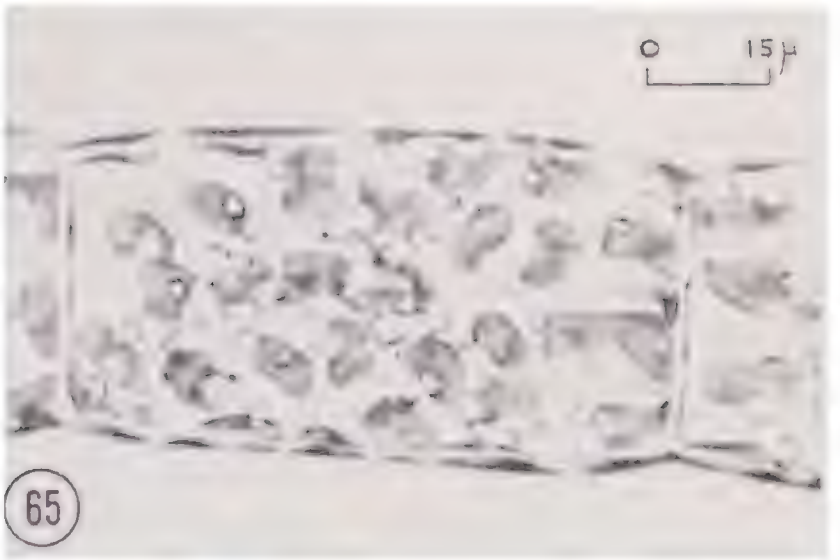

METRIC 1 2 3 4 5
62

63

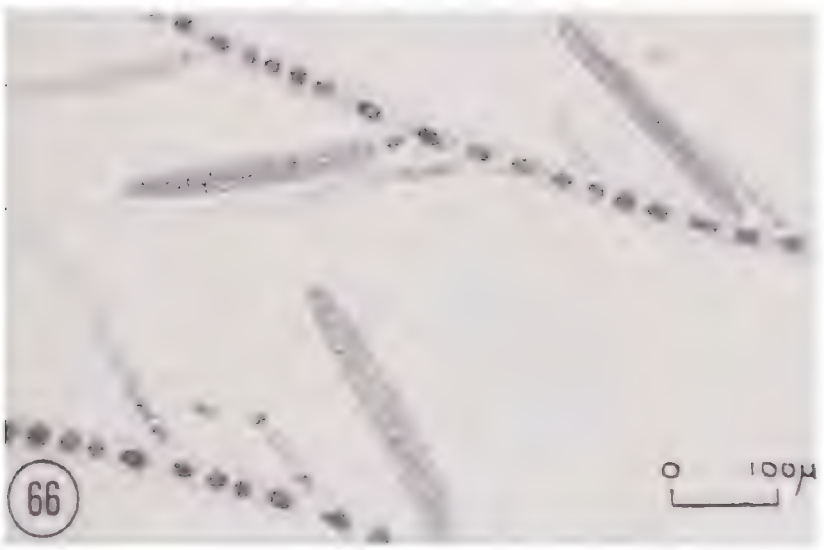
FIGURES 64–71

FIG. 64. *Giffordia rallsiae*; epiphytic on *Gracilaria foliifera*.
FIG. 65. *Giffordia mitchelliae*; detail of a cell showing the discoid plastids and pyrenoids (living material from nature).
FIG. 66. *Giffordia indica*; plurilocular reproductive organs (preserved material).
FIG. 67. *Giffordia mitchelliae*; plurilocular reproductive organs (living material from nature).
FIG. 68. *Giffordia mitchelliae;* detail of a plurilocular reproductive organ (living material from nature).
FIG. 69. *Giffordia mitchelliae*; detail of a unilocular reproductive organ (living material from nature).
FIG. 70. *Giffordia rallsiae*; plurilocular reproductive organs (preserved material).
FIG. 71. *Streblonema oligosporum*; plurilocular reproductive organs (cultured material).

64

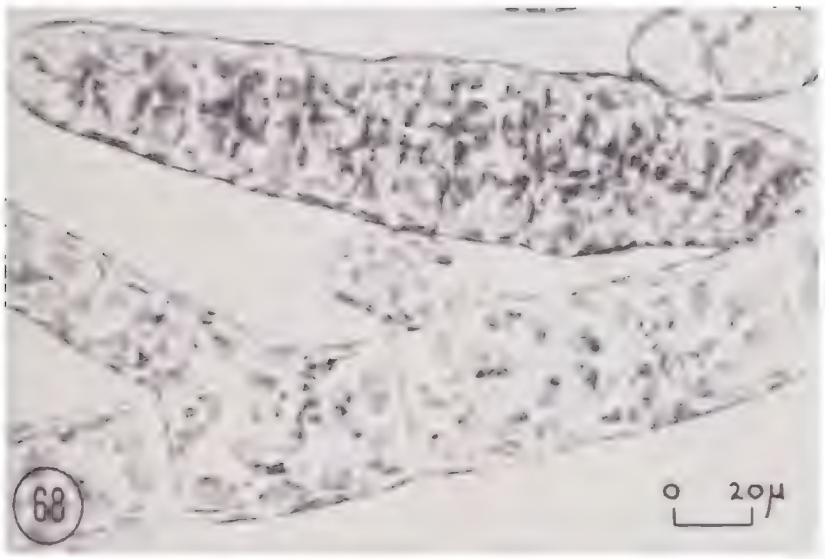


65



66

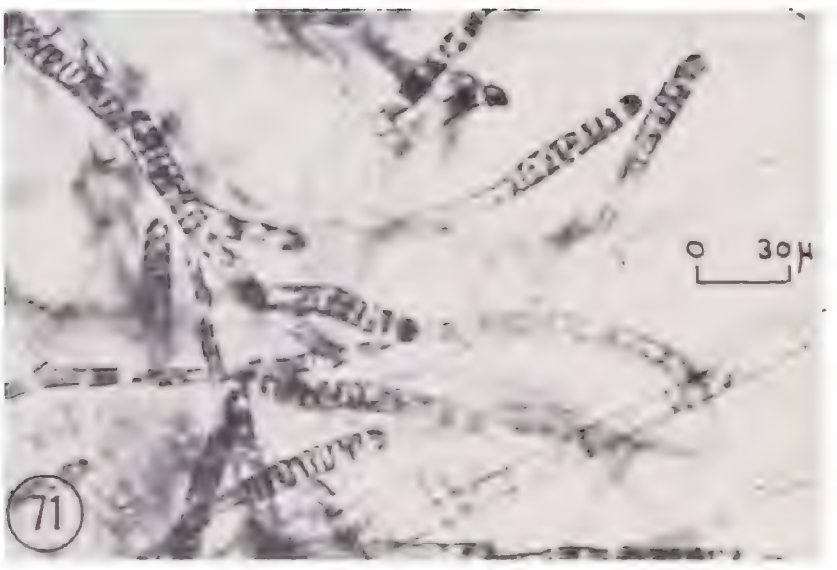
67



68

69

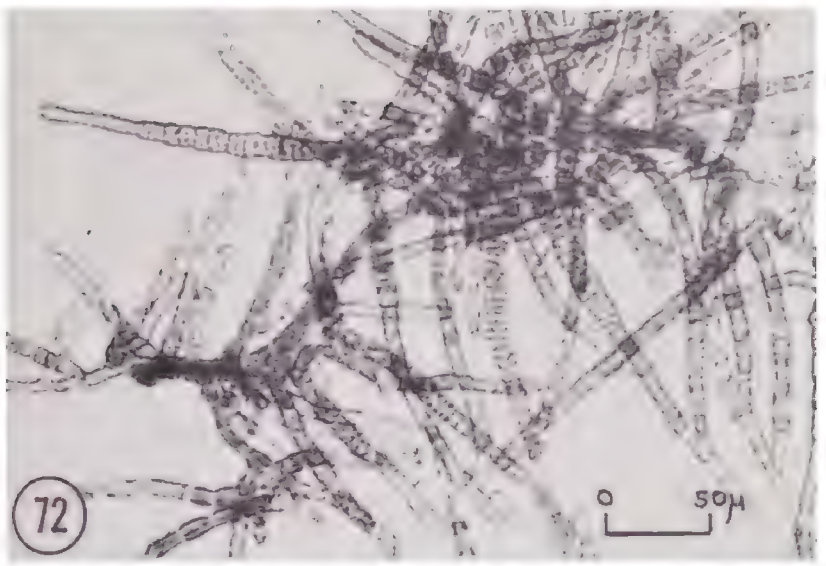
70

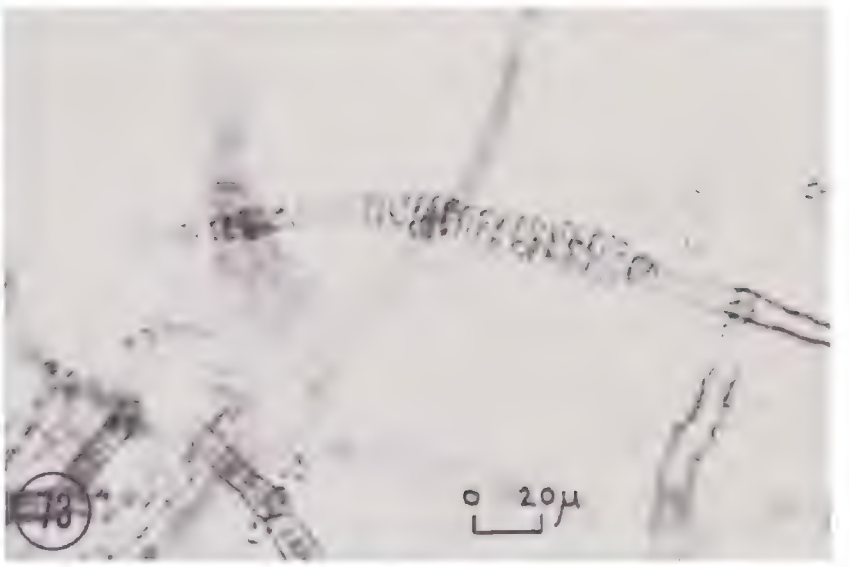


71

FIGURES 72–77

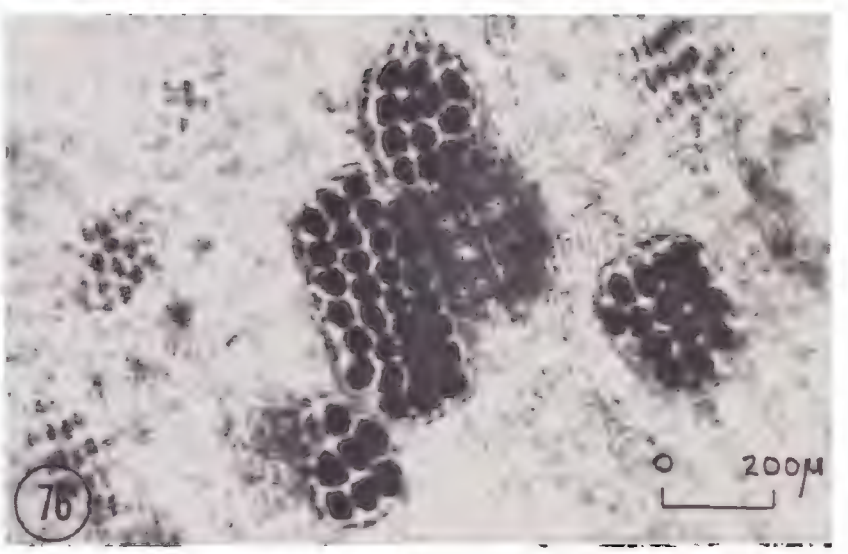
FIG. 72. *Streblonema* sp.: plurilocular reproductive organs (cultured material).
FIG. 73. *Streblonema* sp.; detail of a plurilocular reproductive organ (cultured material).
FIG. 74. *Dictyota dichotoma*.
FIG. 75. *Dictyota dichotoma*; an apex of a branch which has just dichotomized (preserved material).
FIG. 76. *Dictyota dichotoma*; a surface view of oogonial sori (preserved material).
FIG. 77. *Dictyota dichotoma*; tetrasporangia in surface view (preserved material).

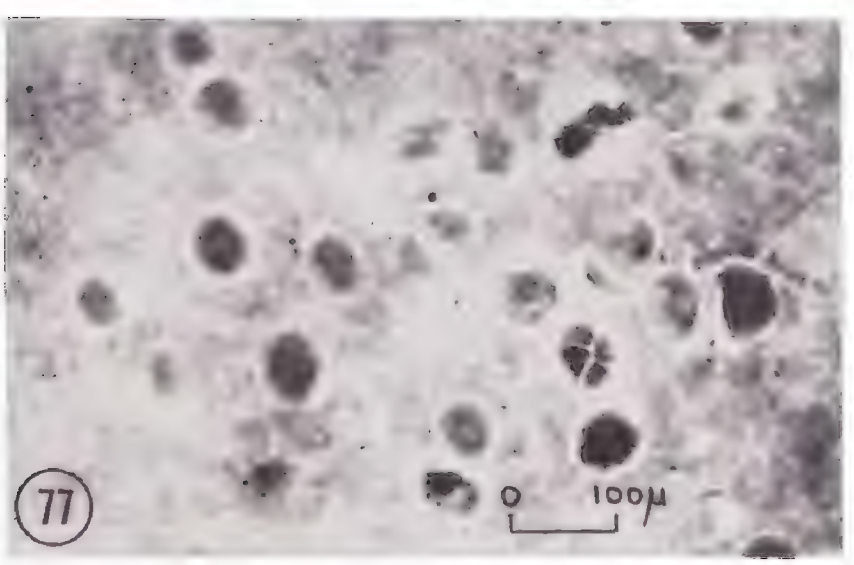

72
0 50μ


73
0 20μ

74
METRIC

0 100μ
75


0 200μ
76


0 100μ
77

FIGURES 78–83

FIG. 78. *Padina vickersiae.*

FIG. 79. *Padina vickersiae*; a portion of a tetrasporangial sorus in surface view (preserved material).

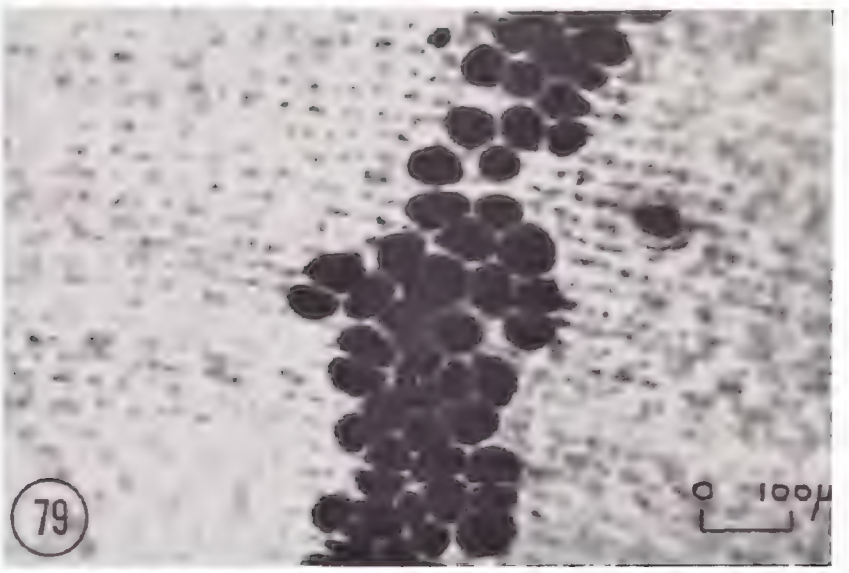
FIG. 80. *Cladosiphon occidentalis.*

FIG. 81. *Cladosiphon occidentalis*; a squashed branch showing the axial medullary filaments and the cortical photosynthetic filaments and hairs (preserevd material).

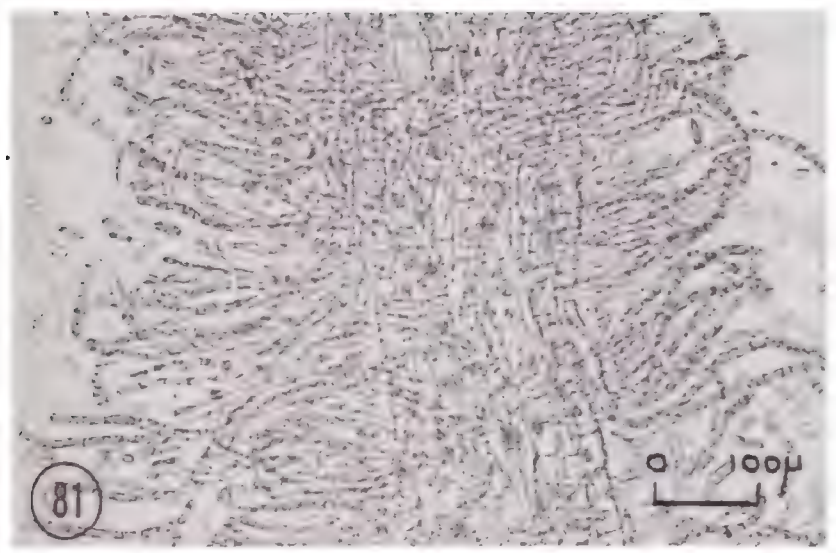
FIG. 82. *Cladosiphon occidentalis*; a unilocular reproductive organ (preserved material).

FIG. 83. *Cladosiphon occidentalis*; plurilocular reproductive organs (preserved material).

78


79
0 100μ

METRIC 1 2 3 4 5
80

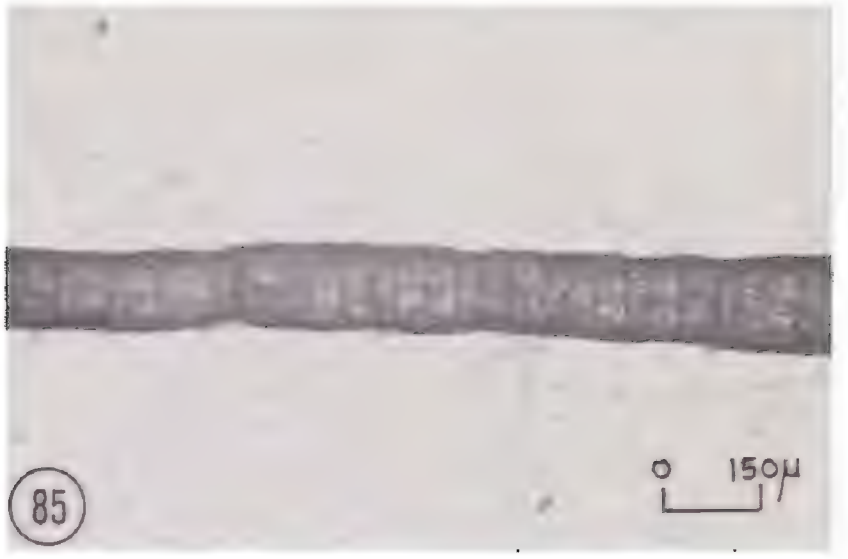

0 100μ
81

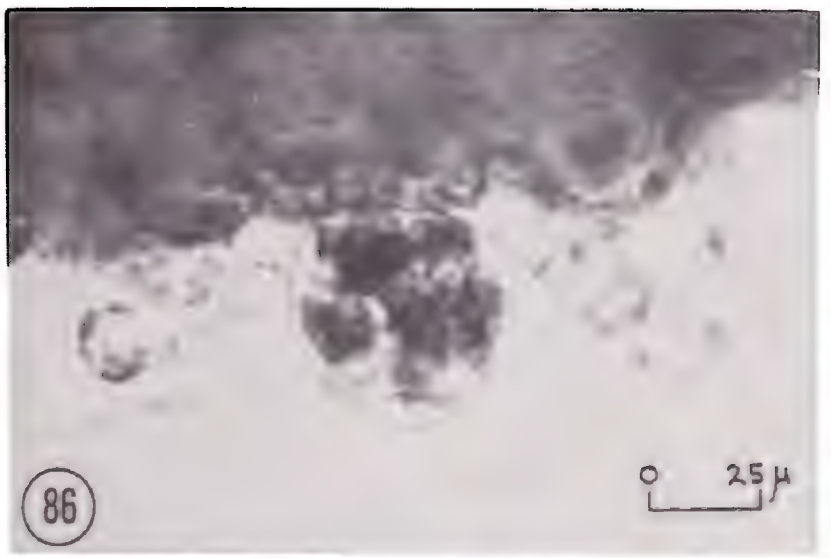
0 40μ
82

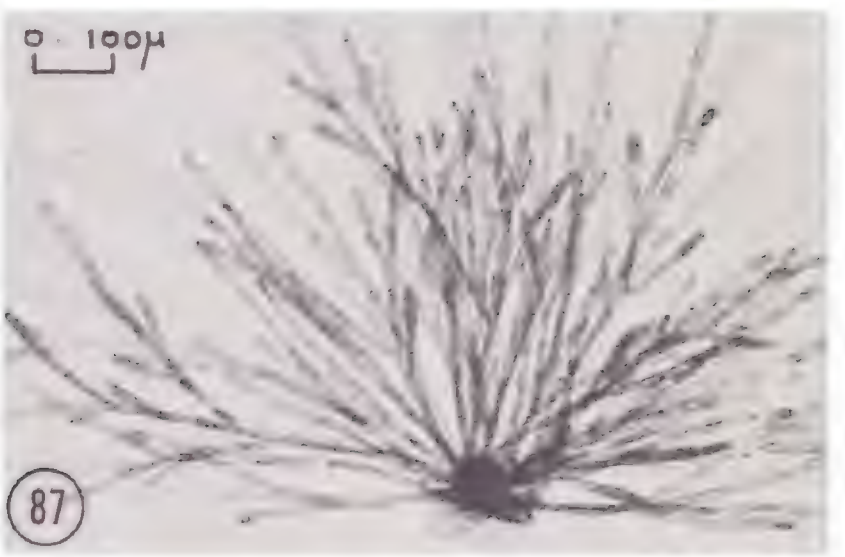
0 40μ
83

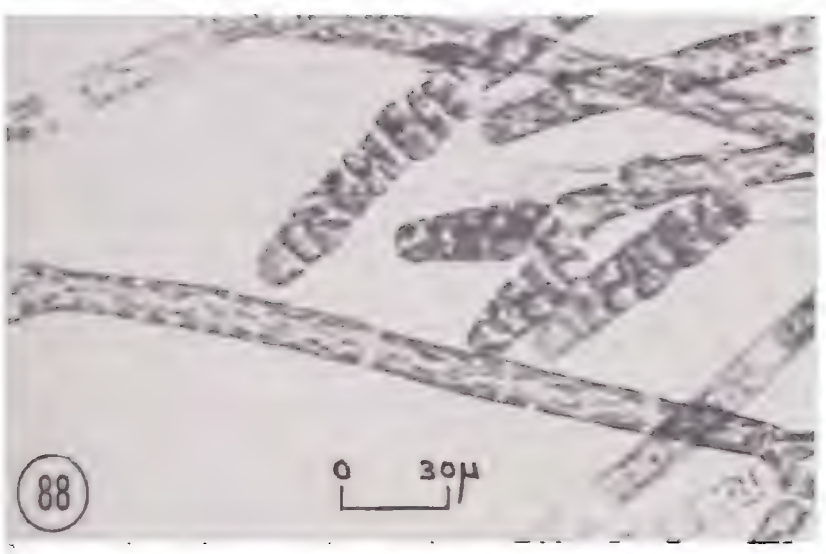
FIGURES 84–90

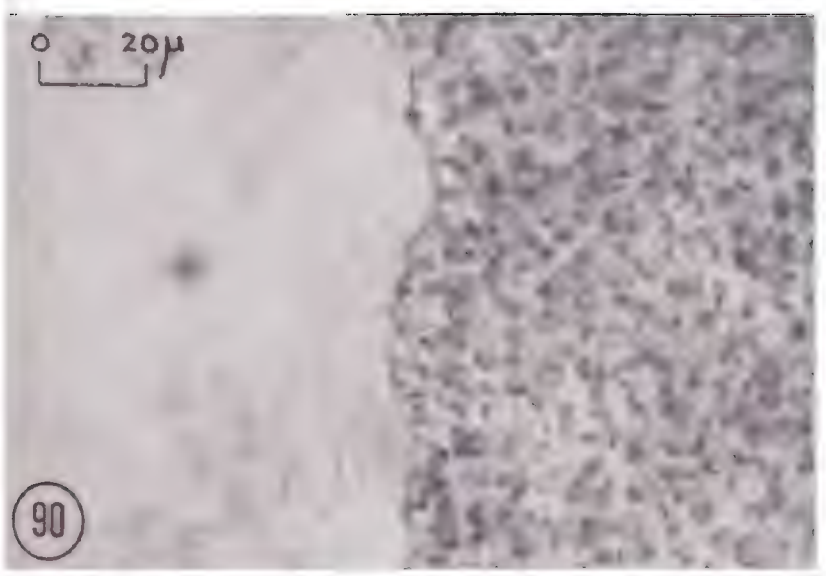
FIG. 84. *Stictyosiphon subsimplex*; epiphytic on *Diplanthera wrightii*.
FIG. 85. *Stictyosiphon subsimplex*; detail of an axis showing the colorless hairs (living material from nature).
FIG. 86. *Stictyosiphon subsimplex*; a unilocular reproductive organ (living material from nature).
FIG. 87. *Myriotrichia subcorymbosa*; the plant habit showing the discoid basal system and the erect filaments bearing colorless hairs and plurilocular reproductive organs (cultured material).
FIG. 88. *Myriotrichia subcorymbosa*; detail of the erect portion showing the cell form, the colorless hairs and the plurilocular reproductive organs (cultural material).
FIG. 89. *Petalonia fascia*.
FIG. 90. *Petalonia fascia*; a surface view of a portion of a plurilocular reproductive organ sorus, to the right of the photograph (living material from nature).



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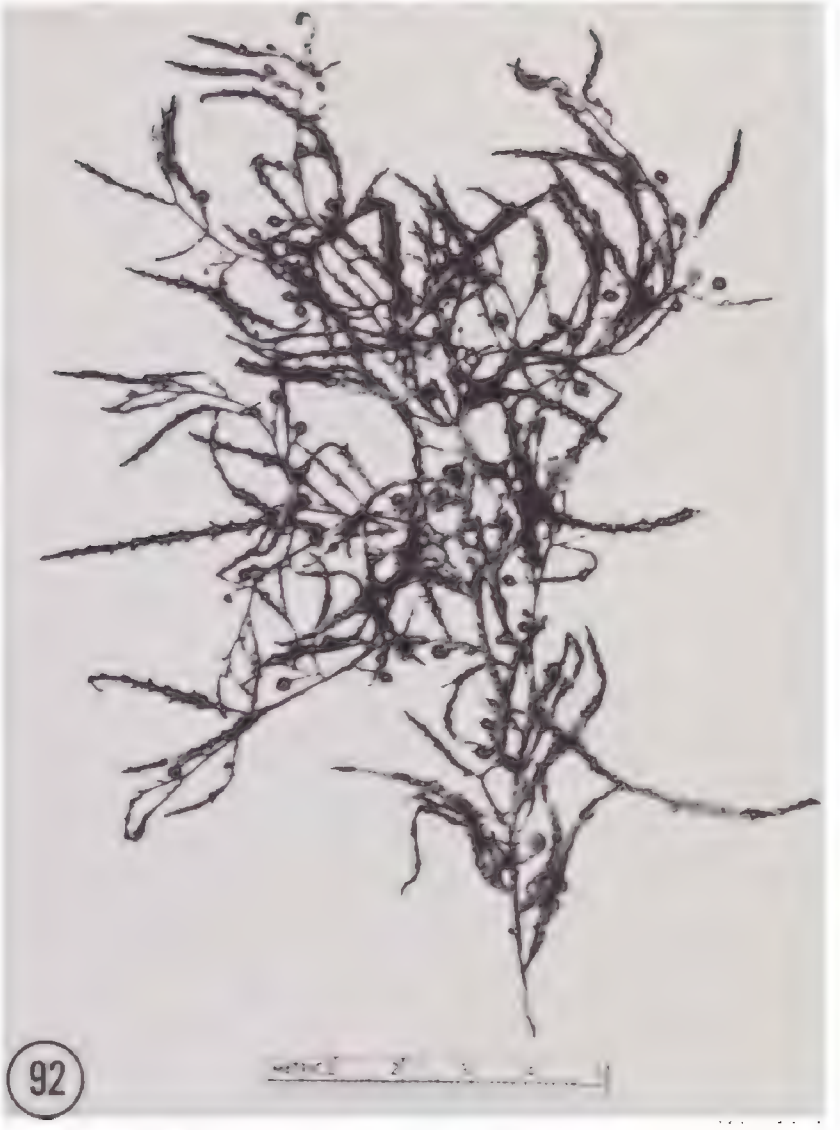
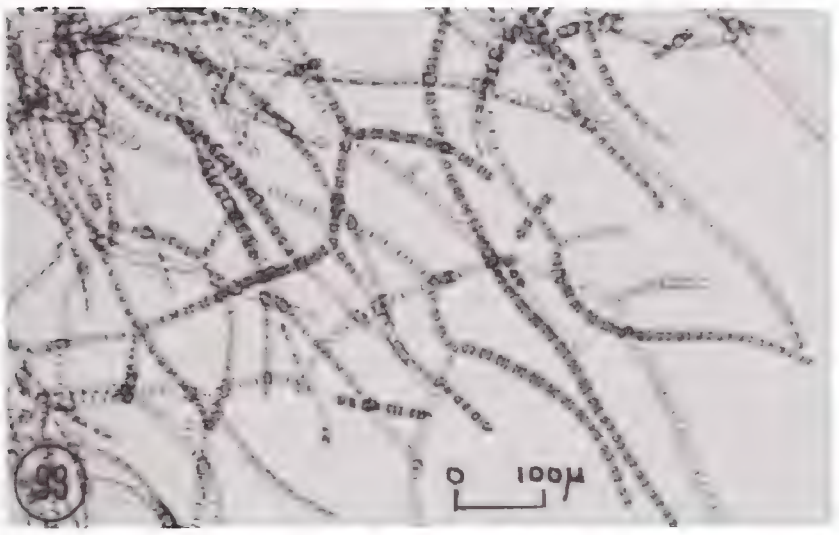
FIGURES 91–96

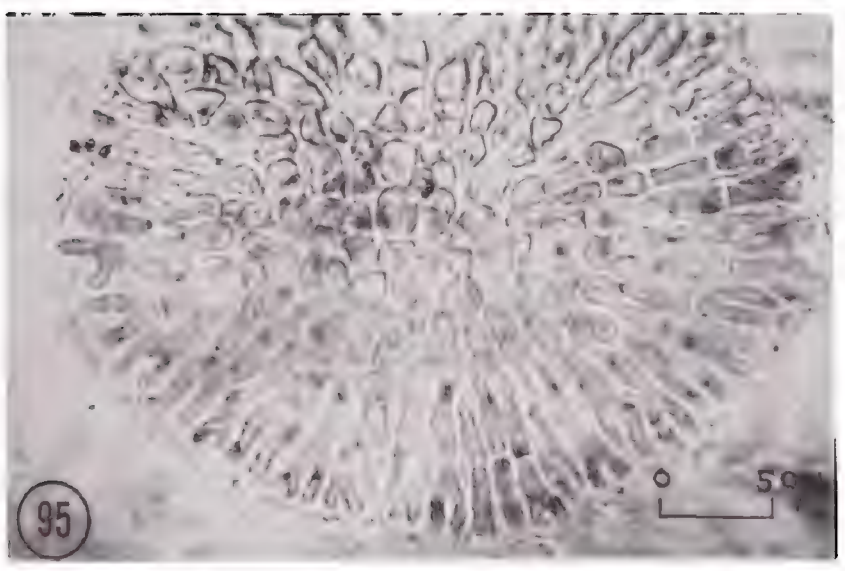
FIG. 91. *Sargassum fluitans.*
FIG. 92. *Sargassum natans.*
FIG. 93. *Asterocytis ramosa*; detail of the filaments (cultured material).
FIG. 94. *Goniotrichum alsidii*; detail of a filament (living material from nature).
FIG. 95. *Erythrocladia subintegra*; epiphytic on *Cladophora vagabunda* (preserved material).
FIG. 96. *Erythrotrichia carnea*; detail of a filament (cultured material).

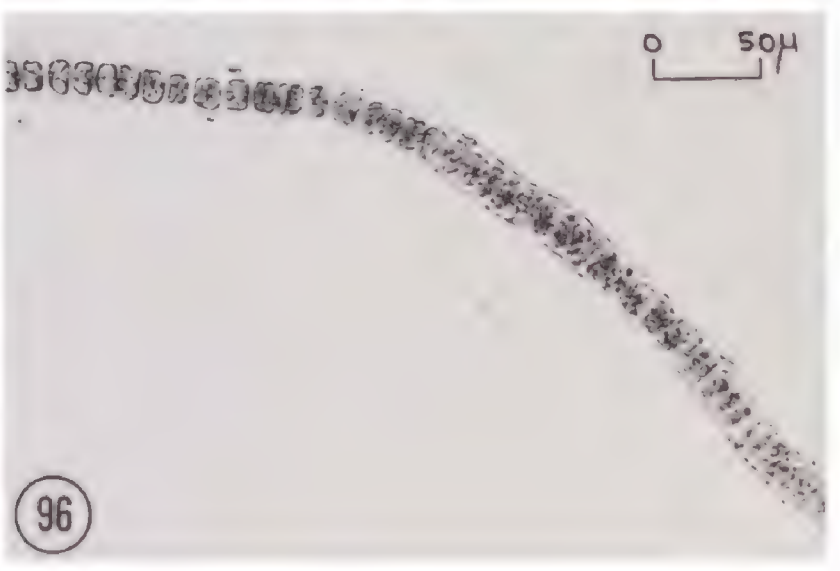
91


92


93
0 100μ

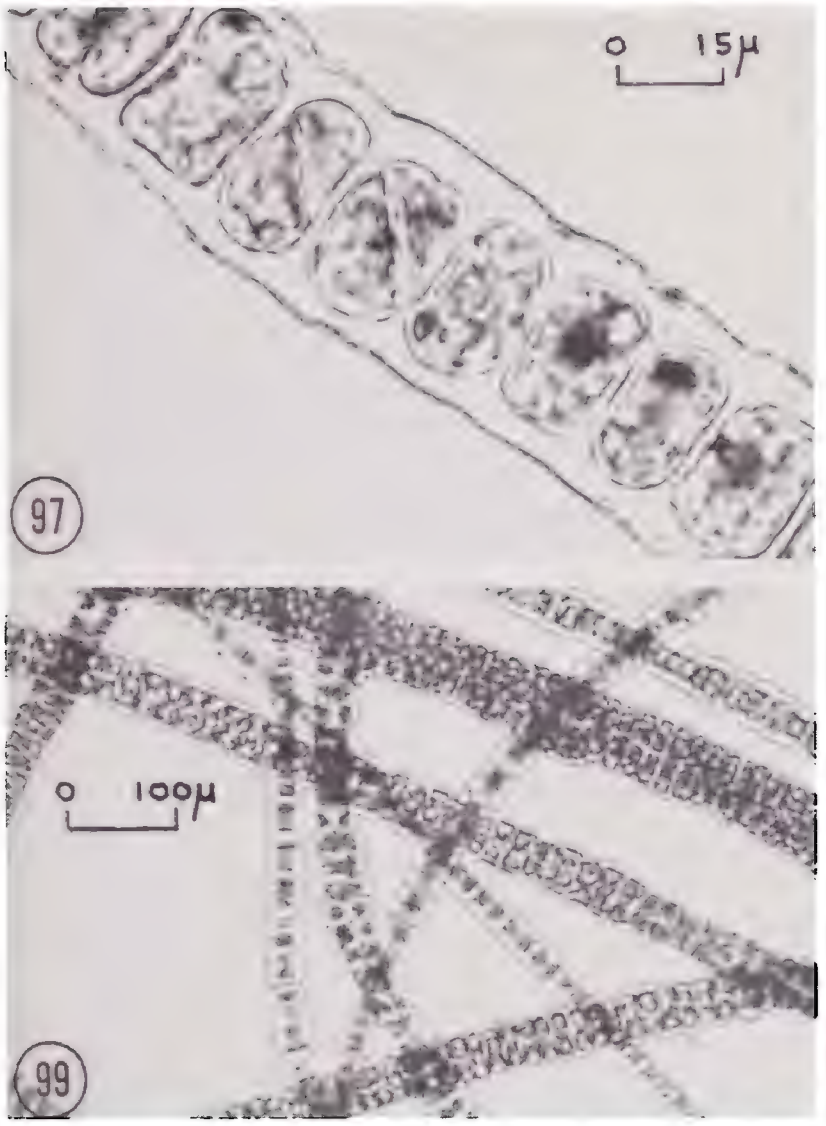
94
0 100μ


95
0 50

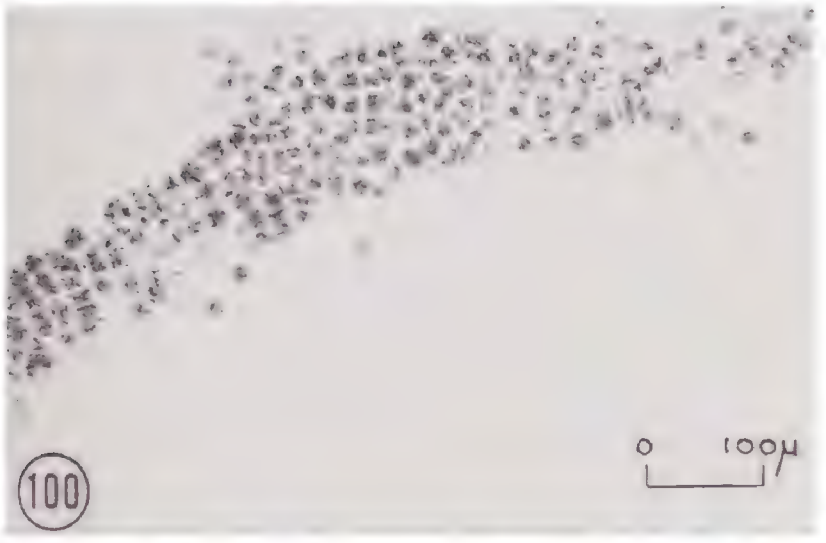

0 50μ
96

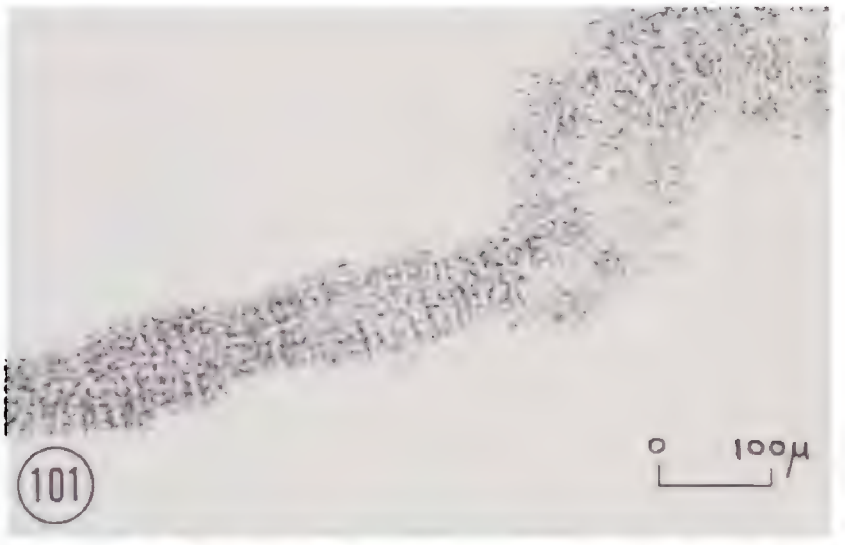
FIGURES 97–103

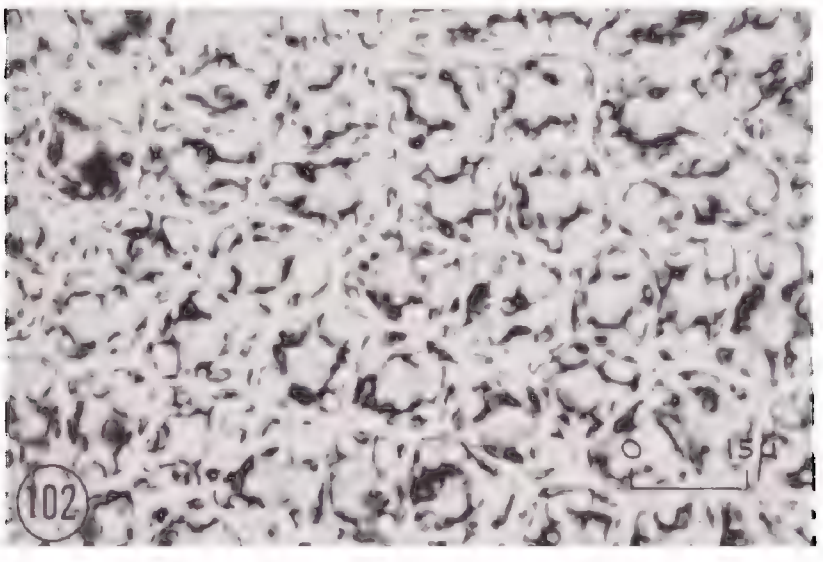
FIG. 97. *Erythrotrichia carnea*; detail of a filament to show the oblique cell division of a vegetative cell to produce a monospore (cultured material).
FIG. 98. *Bangia fuscopurpurea.*
FIG. 99. *Bangia fuscopurpurea*; young uniseriate filaments and more mature pluriseriate filaments (preserved material).
FIG. 100. *Bangia fuscopurpurea*; a filament producing $\alpha$ spores (living material from nature).
FIG. 101. *Bangia fuscopurpurea*; a filament producing $\beta$ spores (living material from nature).
FIG. 102. *Porphyra leucosticta*; detail of the cells to show the stellate plastids (living material from nature).
FIG. 103. *Porphyra leucosticta*; large pigmented $\alpha$ spores and smaller colorless $\beta$ spores (living material from nature).

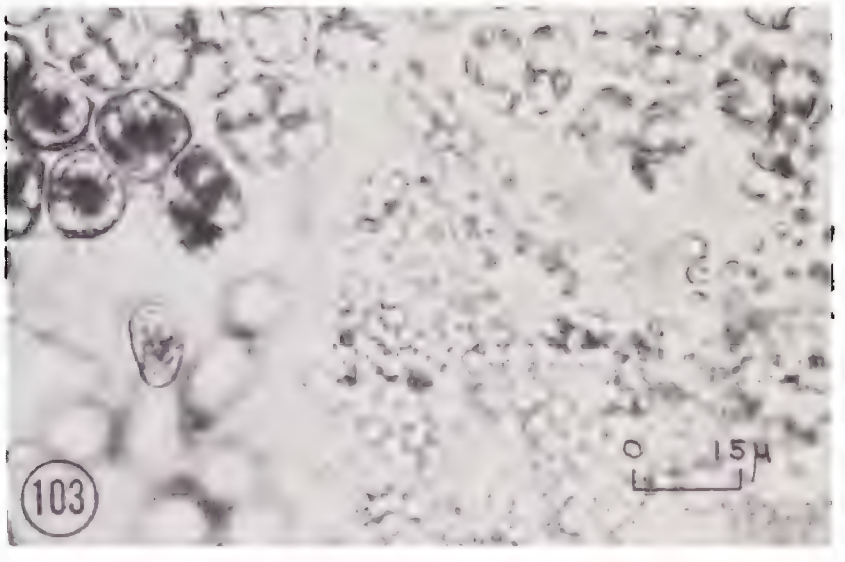

0 15μ
97
0 100μ
99

98
METRIC 1 2 3 4 5


0 100μ
100


0 100μ
101


0 15μ
102


0 15μ
103

FIGURES 104–110

FIG. 104. *Porphyra leucosticta*; the dark and light vertical stripes in the distal portion of the blade are areas of $\alpha$ and $\beta$ spore formation, respectively.

FIG. 105. *Conchocelis* phase of *Porphyra leucosticta* (cultured material).

FIG. 106. *Acrochaetium crassipes*; epiphytic on *Cladophora vagabunda* (preserved material).

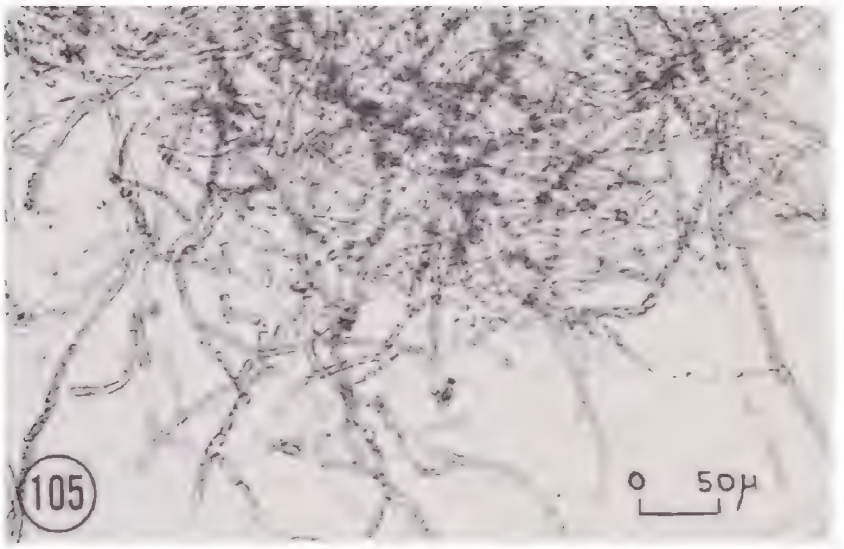
FIG. 107. *Acrochaetium flexuosum*; epiphytic on *Gracilaria foliifera*.

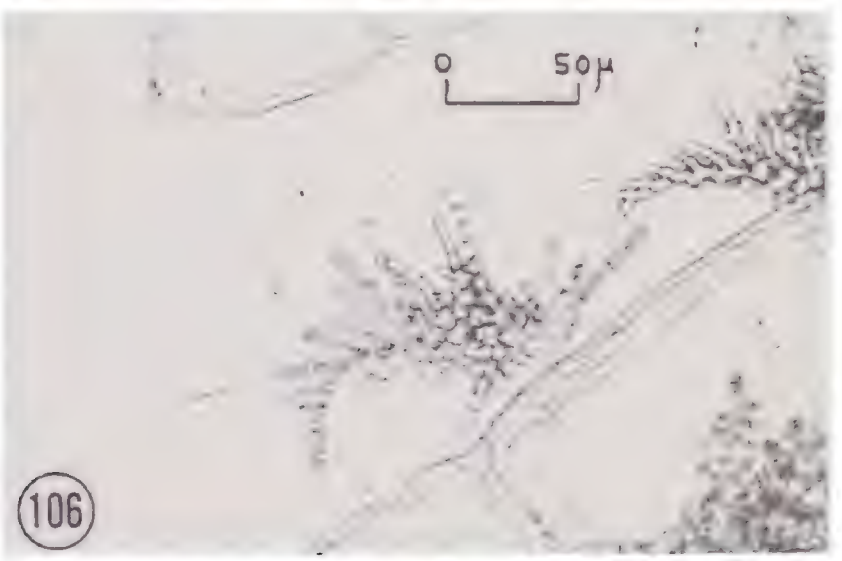
FIG. 108. *Acrochaetium flexuosum*; the release of a monospore from a monosporangium (cultured material).

FIG. 109. *Acrochaetium hoytii*; a portion of a plant showing the basal cell and the erect filaments bearing monosporangia (cultured material).

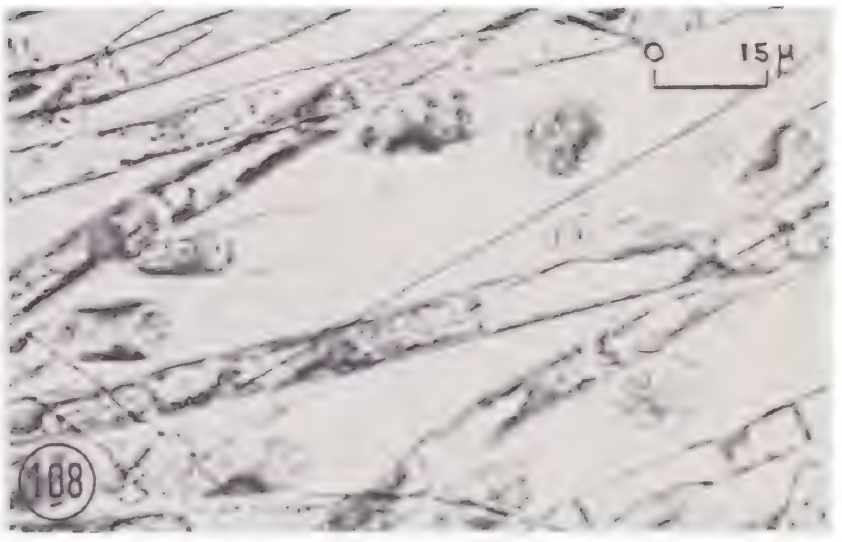
FIG. 110. *Acrochaetium seriatum*; a portion of a plant showing the filamentous basal system and the arrangement of the monosporangia in series on the upper sides of the branches (cultured material).

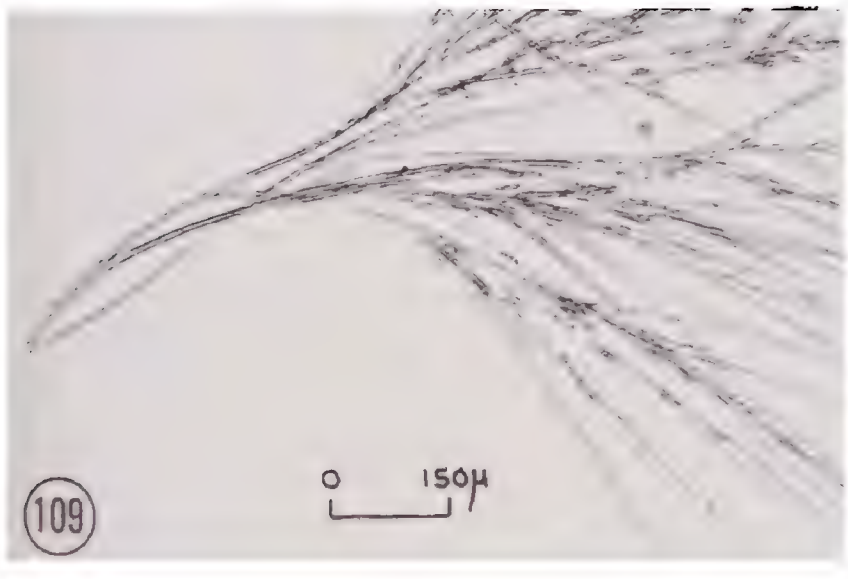
104
METRIC 1 2 3 4 5

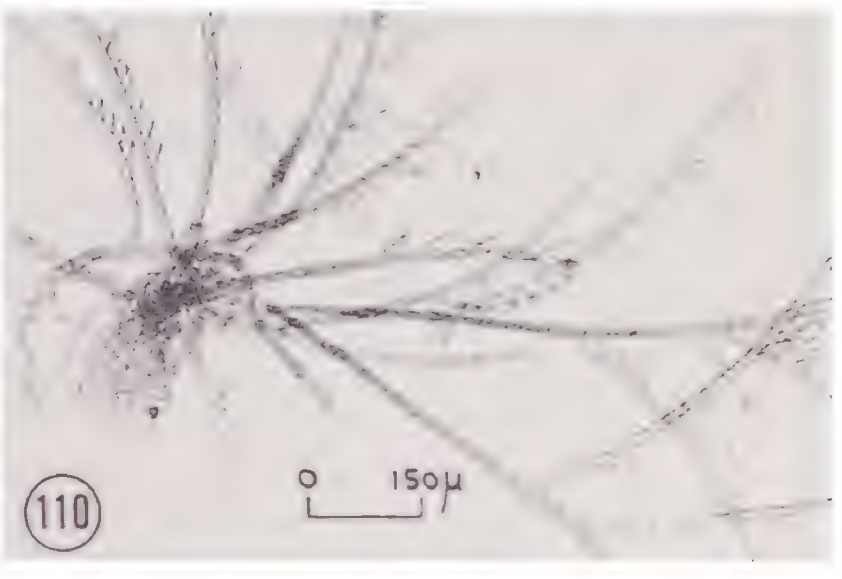

105
0 50μ


0 50μ
106

107

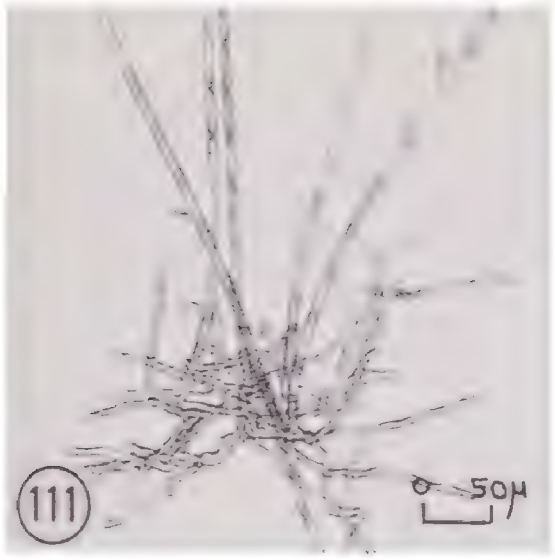

0 15μ
108


0 150μ
109

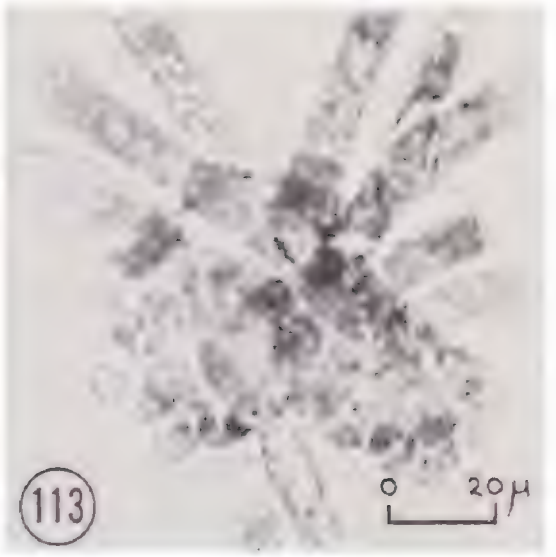

0 150μ
110

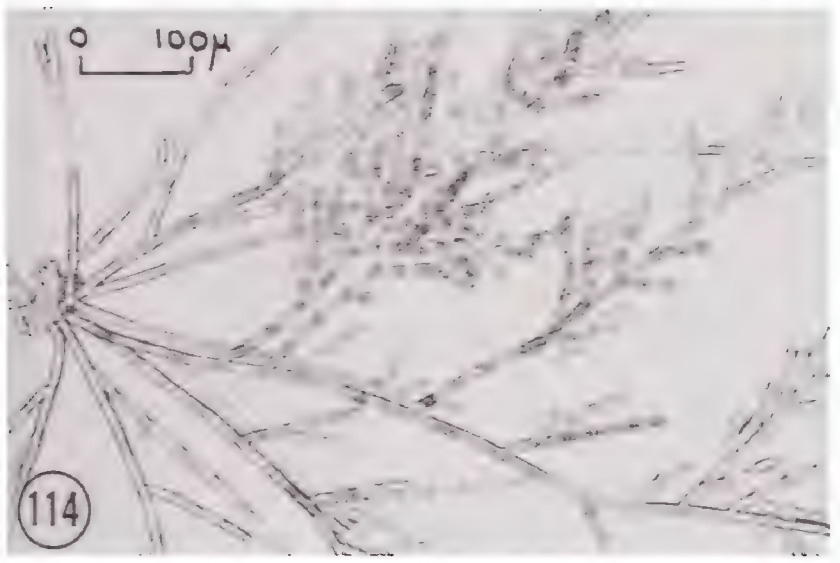
FIGURES 111–119

FIG. 111. *Acrochaetium flexuosum*; detail of the filamentous basal system (cultured material).
FIG. 112. *Acrochaetium hoytii*; detail of the unicellular basal system (cultured material).
FIG. 113. *Acrochaetium virgatulum*; detail of the discoid basal system (cultured material).
FIG. 114. *Acrochaetium virgatulum*; a portion of a plant showing the discoid basal system and the erect filaments bearing colorless hairs and monosporangia (cultured material).
FIG. 115. *Gelidium crinale*; plants from the southwest jetty at Port Aransas.
FIG. 116. *Gelidium crinale*; plants from Aransas Bay.
FIG. 117. *Gelidium crinale*; a hand-cut transverse section of a portion of the axis; the small-celled cortex, the large-celled medulla and the small-celled rhizines interspersed between the latter can be seen (preserved material).
FIG. 118. *Gelidium crinale*; a portion of an antheridial sorus can be seen to the right of the photograph, in surface view.
FIG. 119. *Gelidium crinale*; the distal portion of a plant showing the inflated apices bearing the tetrasporangia (preserved material).


111
50μ

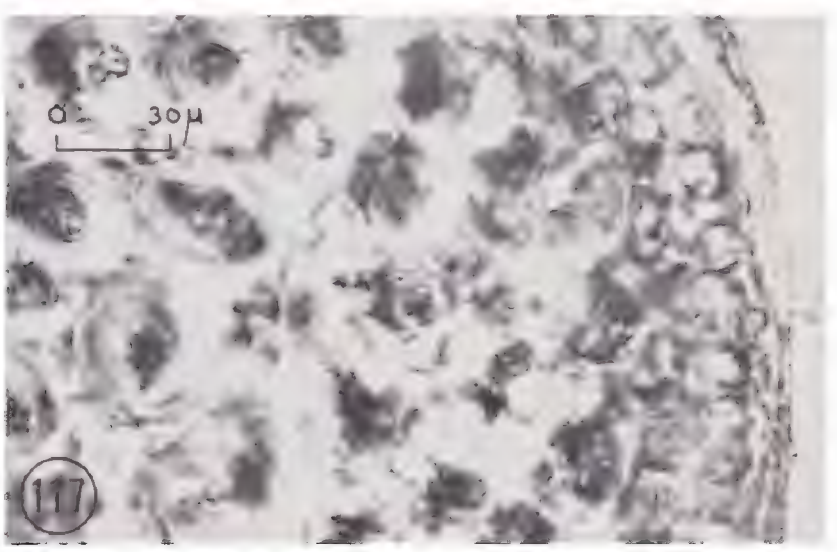
112
40μ

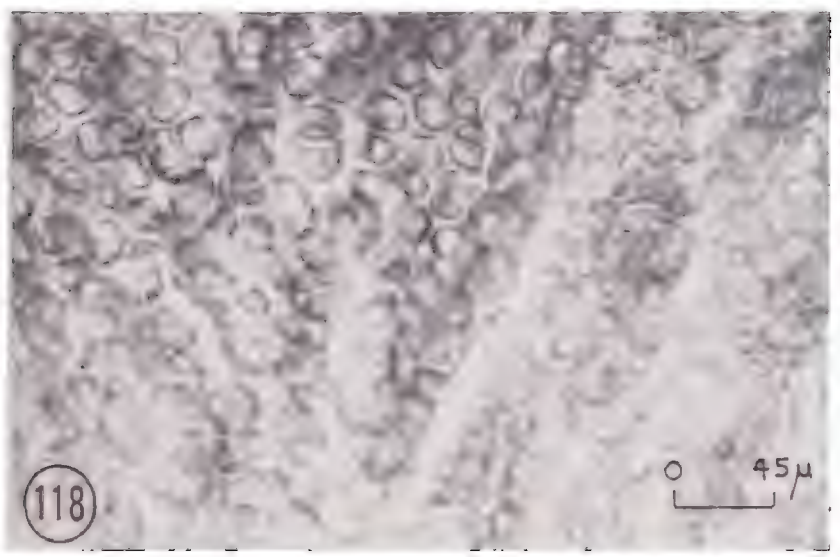

113
20μ


100μ
114

115

116
METRIC 1 2 3


30μ
117

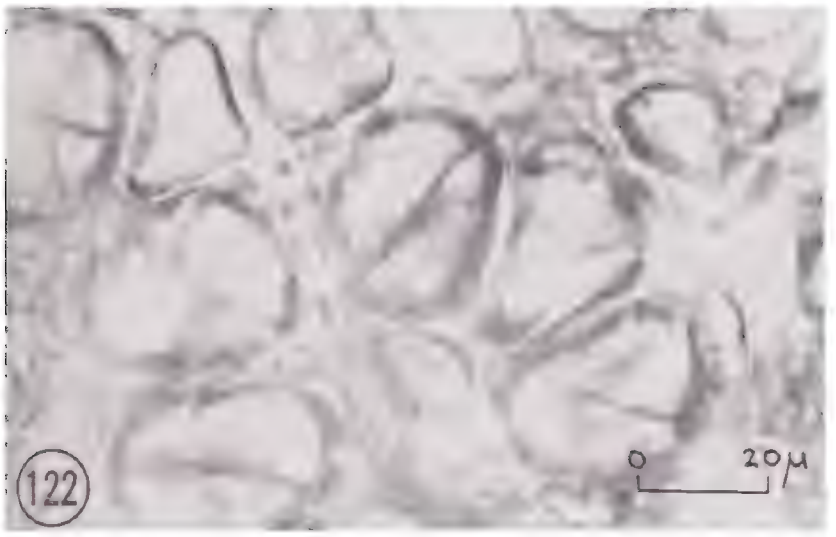

45μ
118

500μ
119

FIGURES 120–126

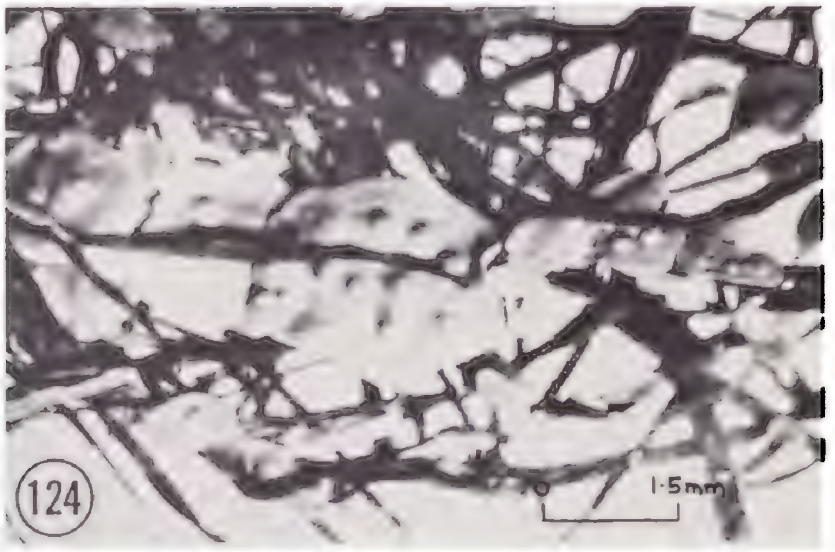
FIG. 120. *Pterocladia bartlettii.*
FIG. 121. *Pterocladia capillacea.*
FIG. 122. *Pterocladia bartlettii*; a surface view of the cruciate tetrasporangia.
FIG. 123. *Heteroderma lejolisii*; epiphytic on *Thalassia testudinum.*
FIG. 124. *Dermatolithon pustulatum*; epiphytic on *Gelidium crinale.*
FIG. 125. *Dermatolithon pustulatum*; epiphytic on *Padina vickersiae*; a hand-cut transverse section of the thallus showing the vertically elongated cells and the superficial cover-cells (decalcified material).
FIG. 126. *Corallina cubensis.*

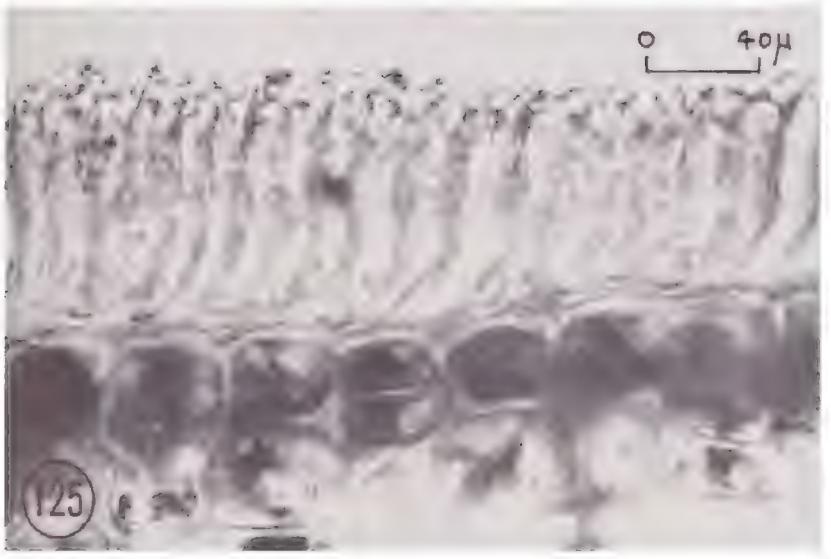
120


122
0
20μ

121
METRIC 1
2
3
4
5

123
0
1·5mm


124
0
1·5mm


125
0
40μ

126
METRIC 1
2
3
4
5

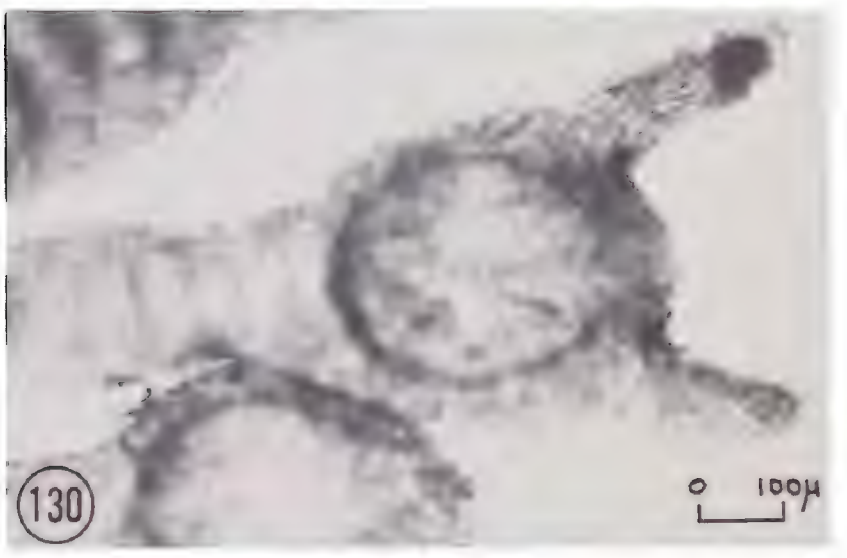
FIGURES 127–133

FIG. 127. *Corallina cubensis*; details of branching (decalcified material).
FIG. 128. *Corallina subulata*.
FIG. 129. *Corallina subulata*; details of branching; conceptacles can be seen on short lateral branchlets (decalcified material).
FIG. 130. *Corallina subulata*; detail of a conceptacle (decalcified material).
FIG. 131. *Jania capillacea*; details of branching; a single conceptacle can be seen.
FIG. 132. *Grateloupia filicina*; a plant with branched main axes.
FIG. 133. *Grateloupia filicina*; a hand-cut transverse section of a portion of the axis; the filamentous medulla can be seen (preserved material).

500μ
127

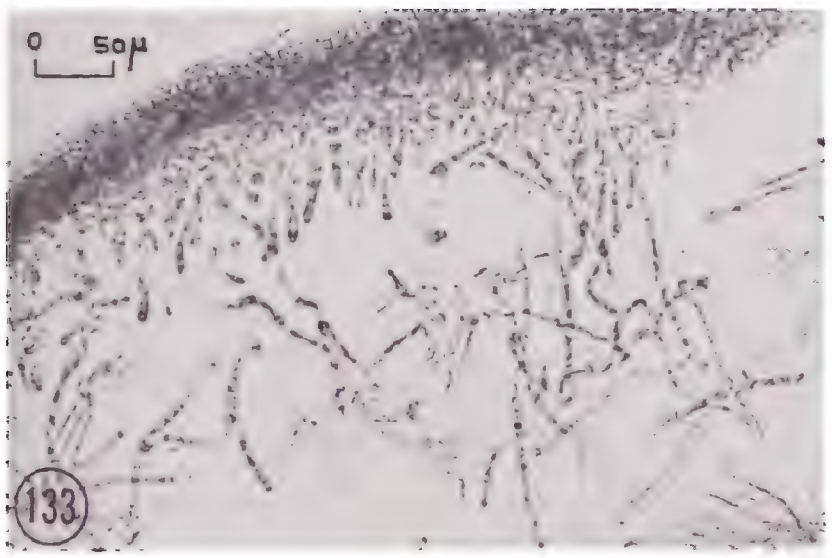
128

500μ
129


100μ
130

1mm
131

132

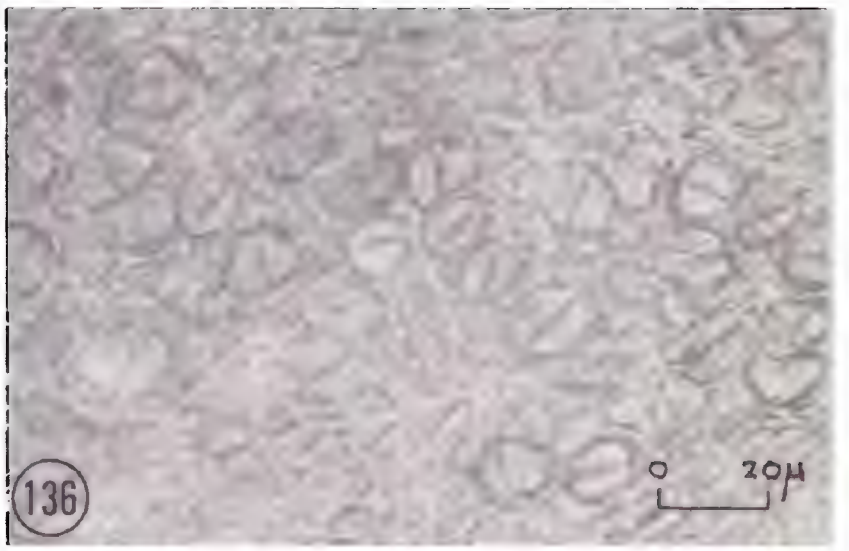

50μ
133

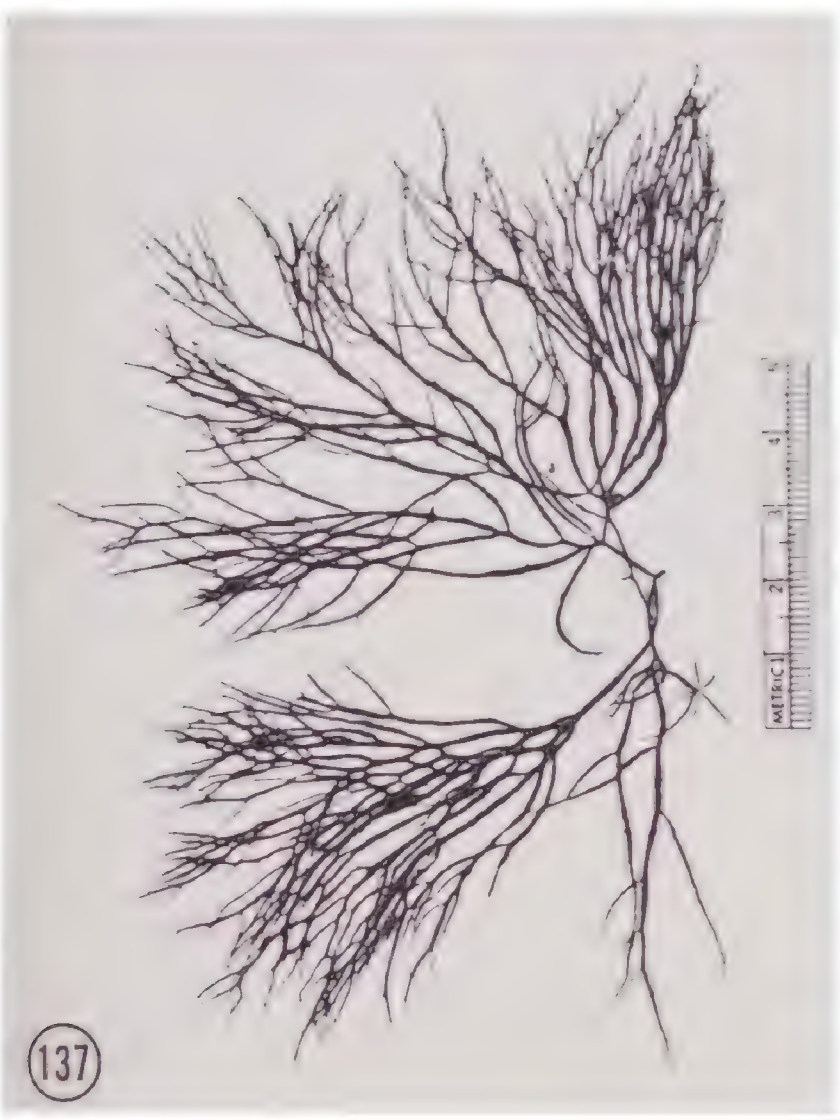
FIGURES 134–139

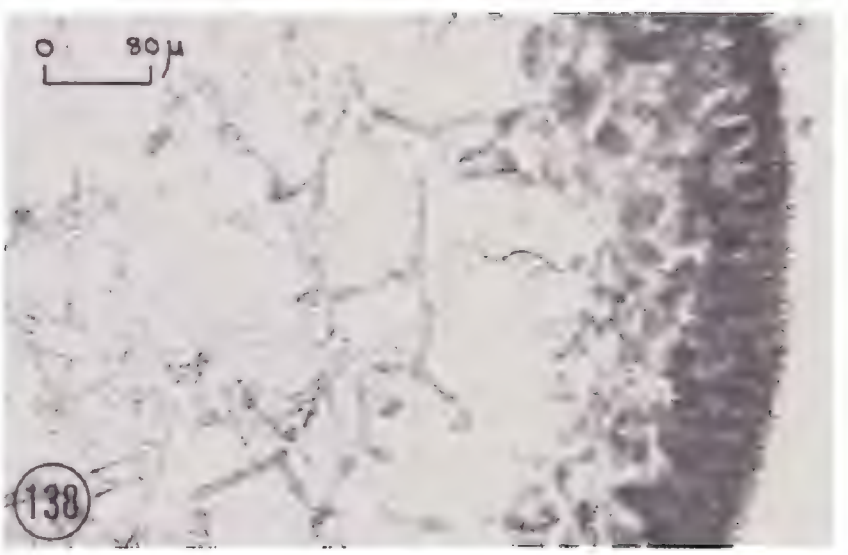
FIG. 134. *Grateloupia filicina*; a plant with largely simple main axes.
FIG. 135. *Grateloupia filicina*; a freezing-microtome transverse section of an axis containing a carposporophyte (preserved material).
FIG. 136. *Grateloupia filicina*; a surface view of the cruciate tetrasporangia.
FIG. 137. *Agardhiella tenera.*
FIG. 138. *Agardhiella tenera*; a hand-cut transverse section of a portion of an axis; the filamentous medulla, the large-celled inner cortex and the small-celled outer cortex can be seen (preserved material).
FIG. 139. *Agardhiella tenera*; a freezing-microtome transverse section of an axis containing a carposporophyte (preserved material).

134

135
0 200μ


136
0 20μ

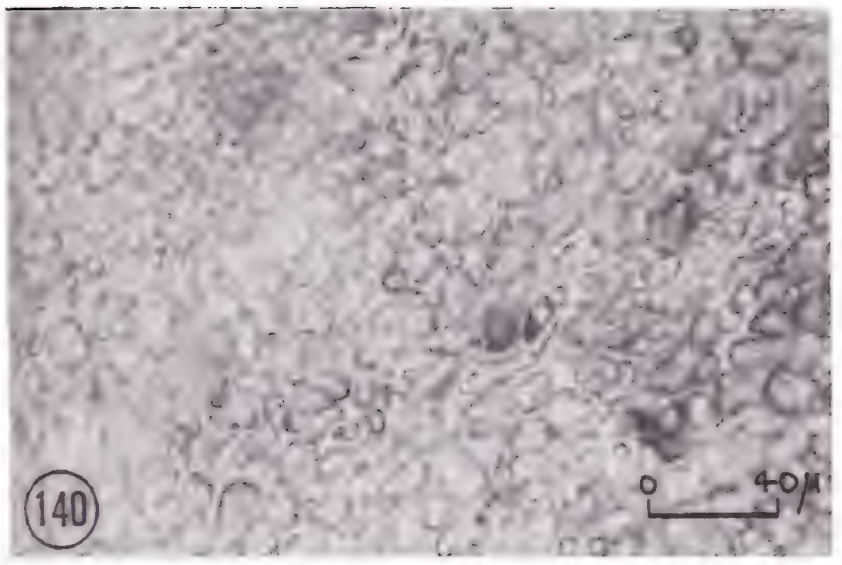

137


0 80μ
138

139
0 400μ

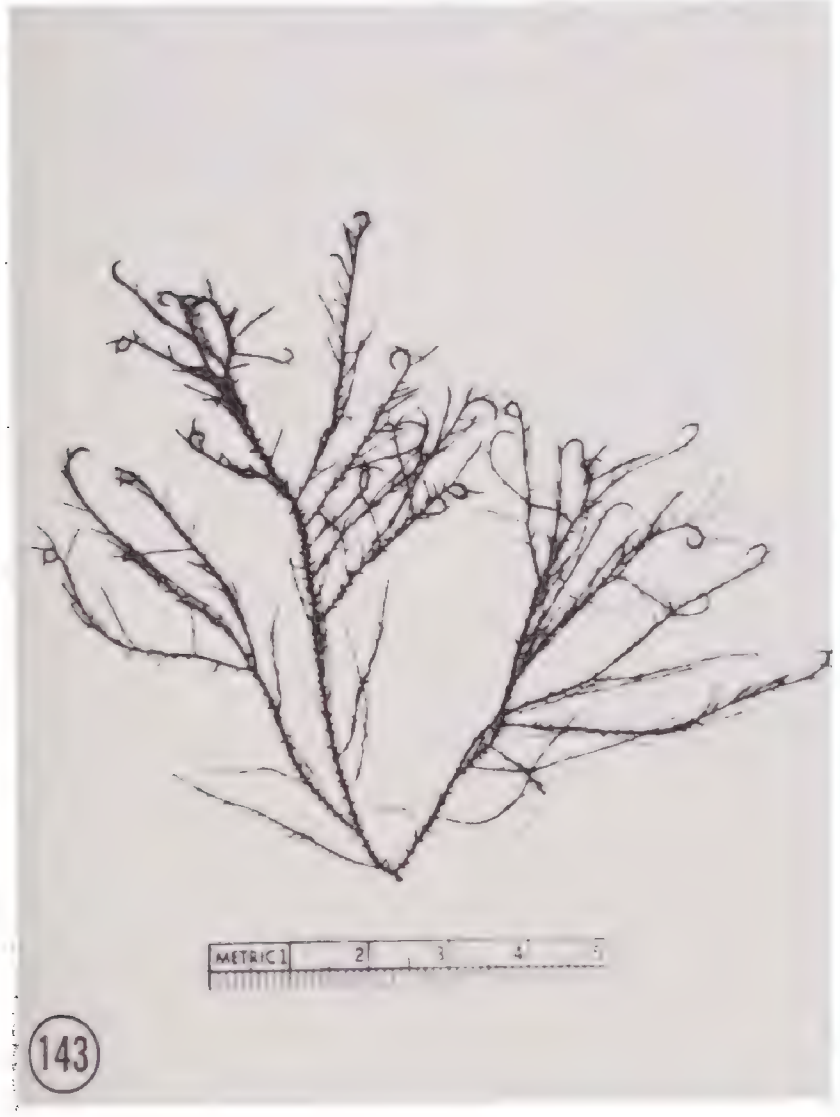
FIGURES 140–144

FIG. 140. *Agardhiella tenera*; a surface view of a portion of an antheridial sorus.
FIG. 141. *Hypnea cornuta.*
FIG. 142. *Hypnea cornuta*; detail of an axis bearing stellate branchlets (preserved material).
FIG. 143. *Hypnea musciformis*; a plant with recurved branch apices.
FIG. 144. *Hypnea musciformis*; a plant without recurved branch apices.


140
0 40μ

0 500μ
142

141


METRIC 1 2 3 4 5
143

144

FIGURES 145–150

FIG. 145. *Hypnea musciformis*; a hand-cut transverse section of an axis; a small-celled cortex surrounds a large celled medulla at the center of which a central axial cell can be recognized (preserved material).

FIG. 146. *Hypnea musciformis;* detail of a portion of a plant bearing cystocarps (preserved material).

FIG. 147. *Hypnea musciformis*: a hand-cut transverse section of an axis with zonate tetrasporangia in the cortex (preserved material).

FIG. 148. *Gracilaria debilis*.

FIG. 149. *Gracilaria foliifera*; a plant with the flattening of the axis confined to just below the forkings of the branches.

FIG. 150. *Gracilaria foliifera*; a compact, richly branched plant.

145
0 100μ

0 500μ
146

147
0 40μ

148

149

150

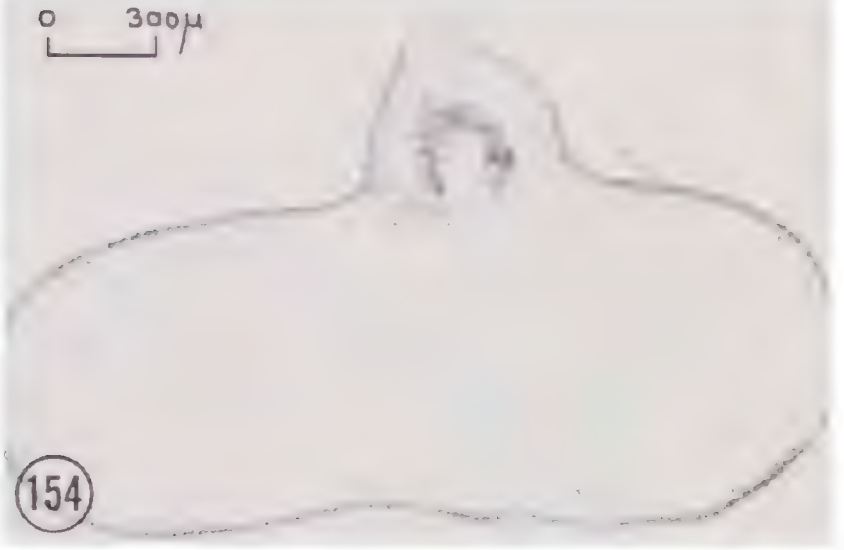
FIGURES 151–156

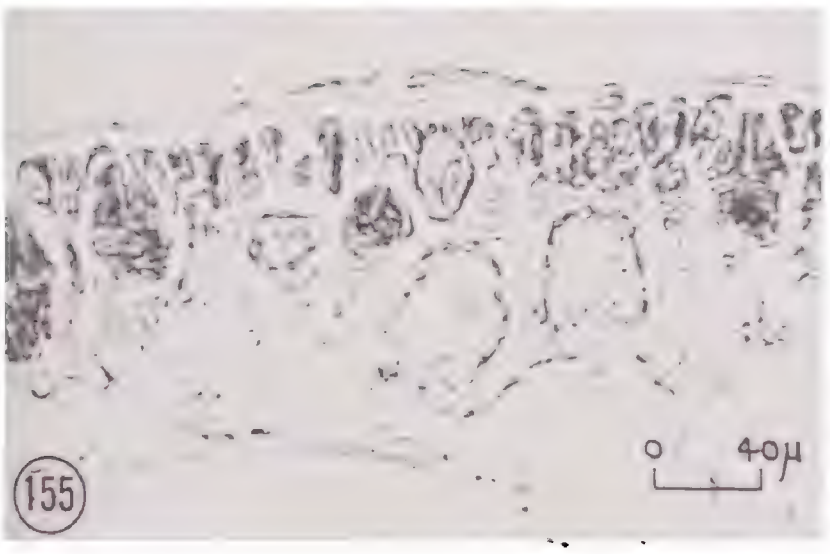
FIG. 151. *Gracilaria foliifera*; a plant with distinctly flattened axes.
FIG. 152. *Gracilaria verrucosa.*
FIG. 153. *Gracilaria foliifera*; a surface view of a portion of an antheridial sorus.
FIG. 154. *Gracilaria foliifera*; a freezing-microtome transverse section of an axis bearing a cystocarp (preserved material).
FIG. 155. *Gracilaria foliifera*; a freezing-microtome transverse section of an axis with cruciate tetrasporangia in the cortex (preserved material).
FIG. 156. *Rhodymenia pseudopalmata*; a freezing-microtome transverse section of an axis; a small-celled cortex surrounds a large-celled medulla (preserved material).

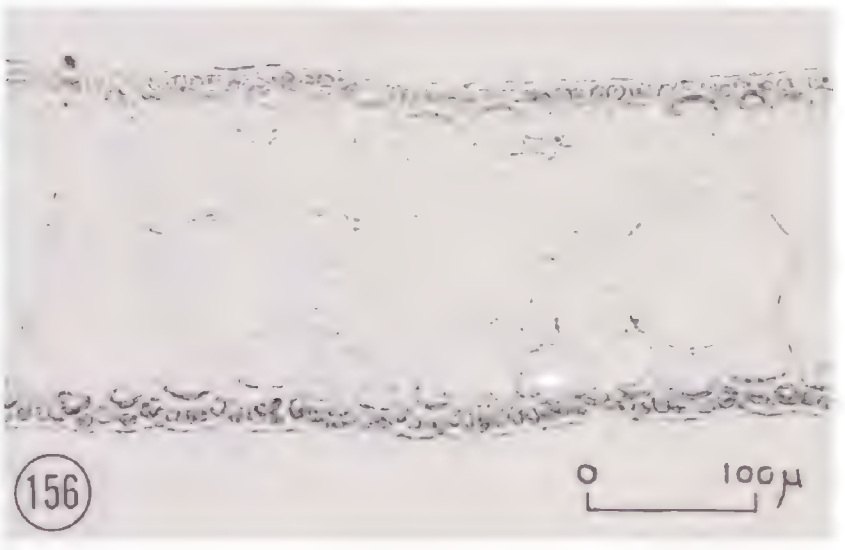
151

0 300μ
152

0 40μ
153


154


0 40μ
155

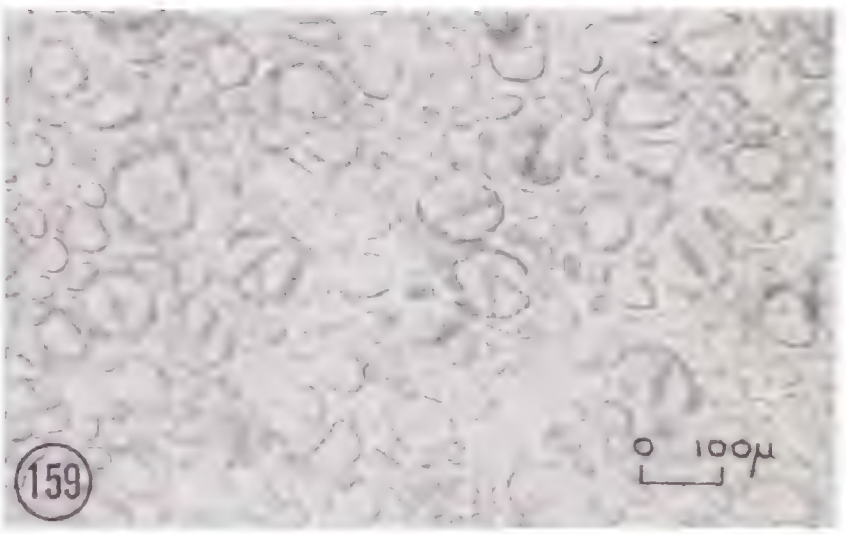

0 100μ
156

FIGURES 157–163

FIG. 157. *Rhodymenia pseudopalmata.*
FIG. 158. *Rhodymenia pseudopalmata*; a surface view of a portion of an antheridial sorus.
FIG. 159. *Rhodymenia pseudopalmata*; a surface view of the cruciate tetrasporangia.
FIG. 160. *Lomentaria baileyana.*
FIG. 161. *Lomentaria baileyana*; detail of the axes (preserved material).
FIG. 162. *Champia parvula.*
FIG. 163. *Champia parvula*; detail of the axes (preserved mtaerial).

157

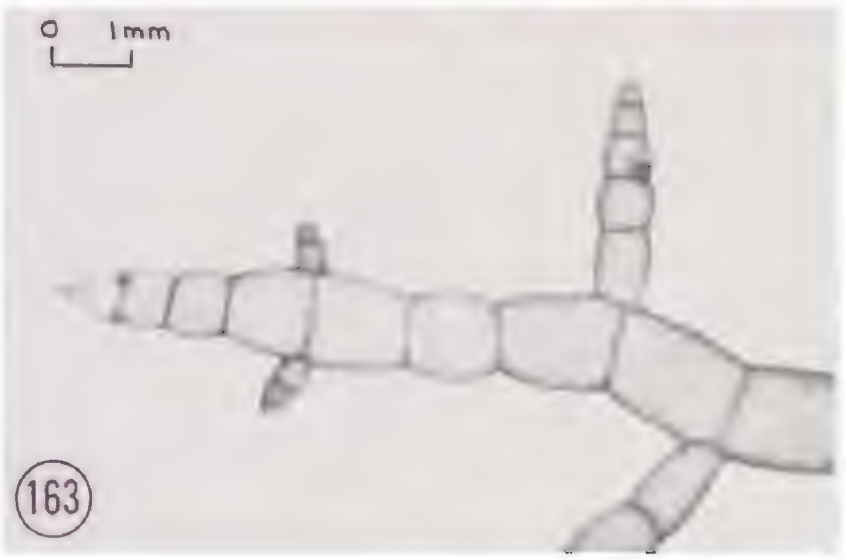
158
0 25μ


159
0 100μ

160

161
0 1mm

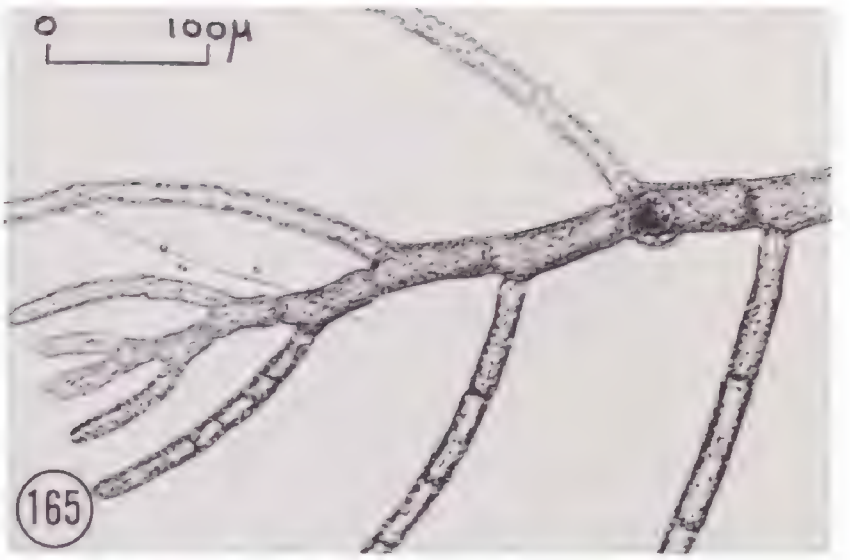
162


163
0 1mm

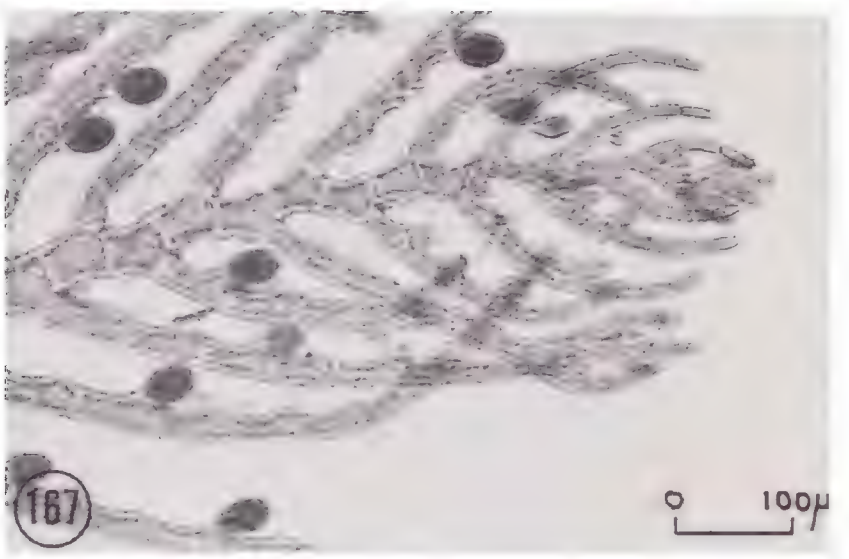
FIGURES 164–171.

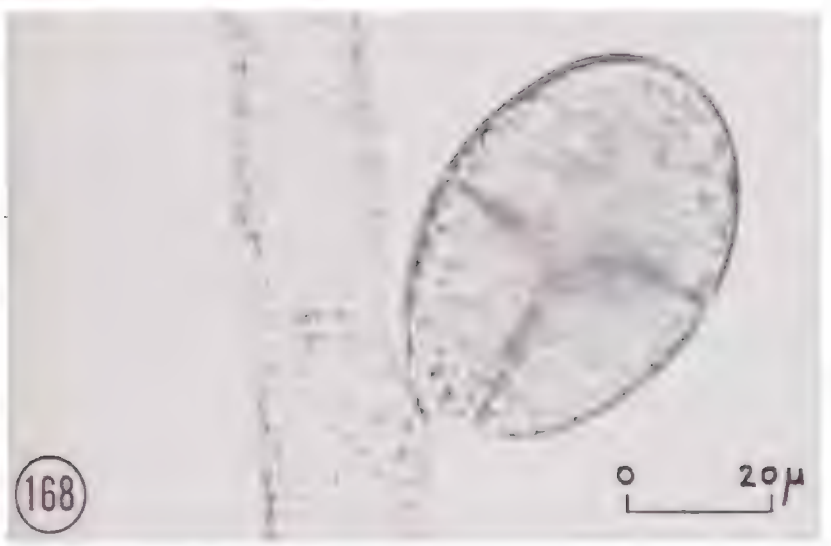
FIG. 164. *Callithamnion byssoides*; antheridia (cultured material).
FIG. 165. *Callithamnion byssoides*; a carpogonium bearing an elongated trichogyne on which adherent spermatia can be seen (cultured material).
FIG. 166. *Callithamnion byssoides*; carposporophytes (cultured material).
FIG. 167. *Callithamnion byssoides*; tetrasporangia (preserved material).
FIG. 168. *Callithamnion byssoides*; detail of a tetrasporangium showing the tetrahedral type of division (cultured material).
FIG. 169. *Griffithsia tenuis*; the apex of a filament (living material from nature).
FIG. 170. *Spermothamnion* sp.
FIG. 171. *Spermothamnion* sp.; vegetative filaments (cultured material).

0 100μ
164


0 100μ
165

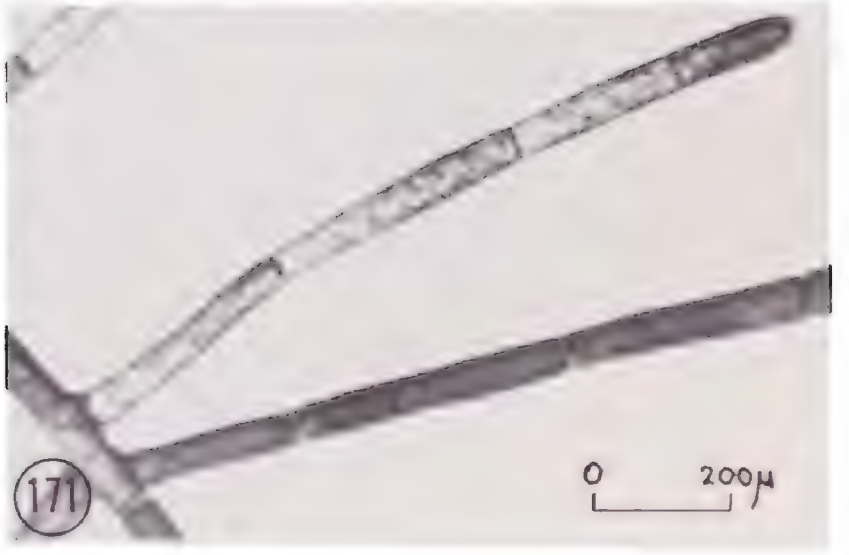
166
0 100μ


167
0 100μ


168
0 20μ

169
0 200μ

170


171
0 200μ

FIGURES 172–179

FIG. 172. *Ceramium fastigiatum* f. *flaccida.*

FIG. 173. *Ceramium byssoideum*; the upper portion of a filament showing the pattern of cortication and the pincer-like apices of the branches (preserved material).

FIG. 174. *Ceramium byssoideum*; detail of the nodes showing the pattern of cortication (preserved material).

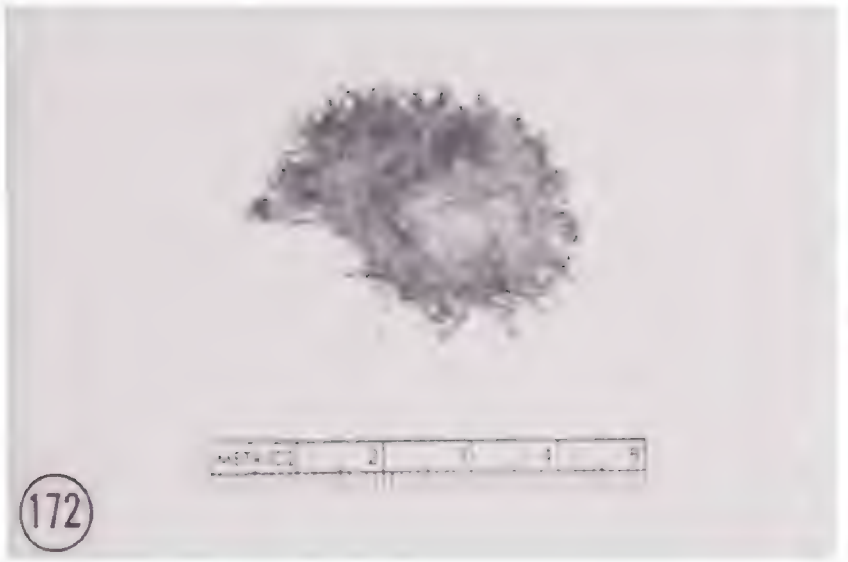
FIG. 175. *Ceramium fastigiatum* f. *flaccida*; detail of the nodes showing the pattern of cortication (preserved material).

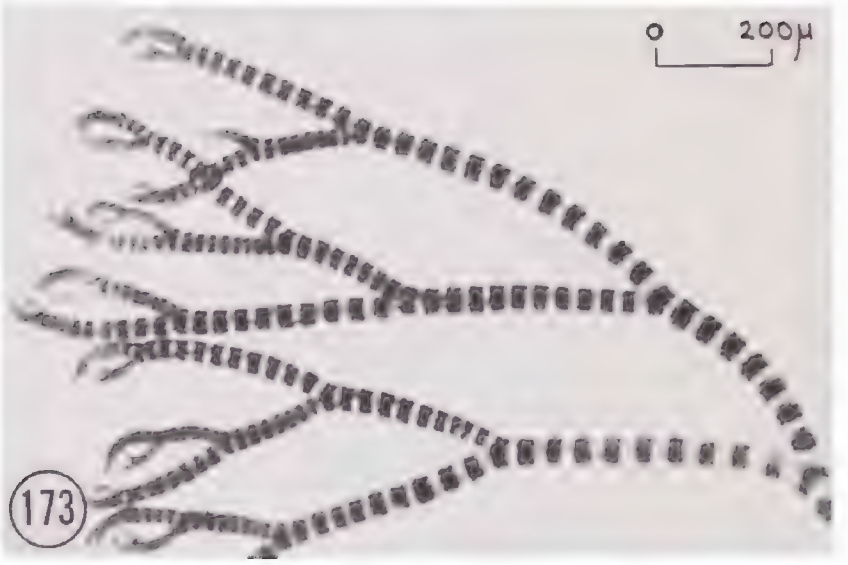
FIG. 176. *Ceramium strictum*; detail of the nodes showing the pattern of cortication (preserved material).

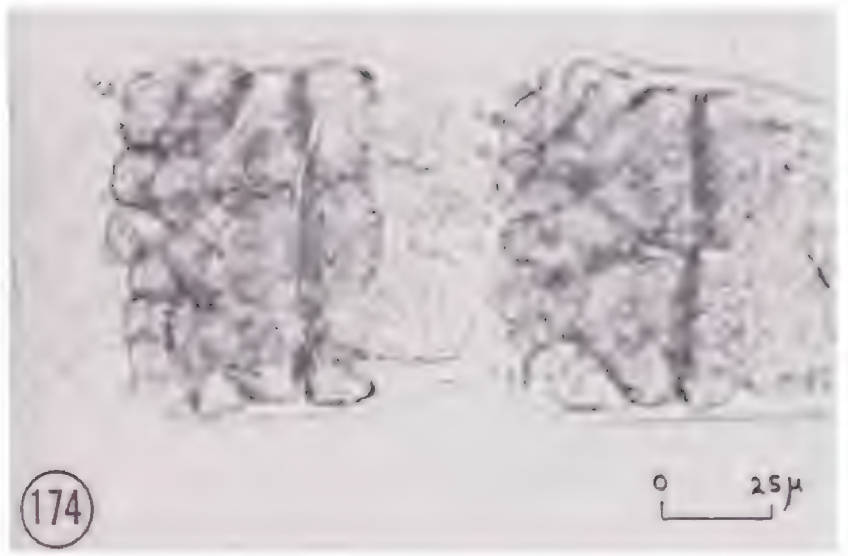
FIG. 177. *Ceramium strictum*; carposporophytes (preserved material).

FIG. 178. *Ceramium strictum*; tetrasporangia (preserved material).

FIG. 179. *Centroceras clavulatum.*


172

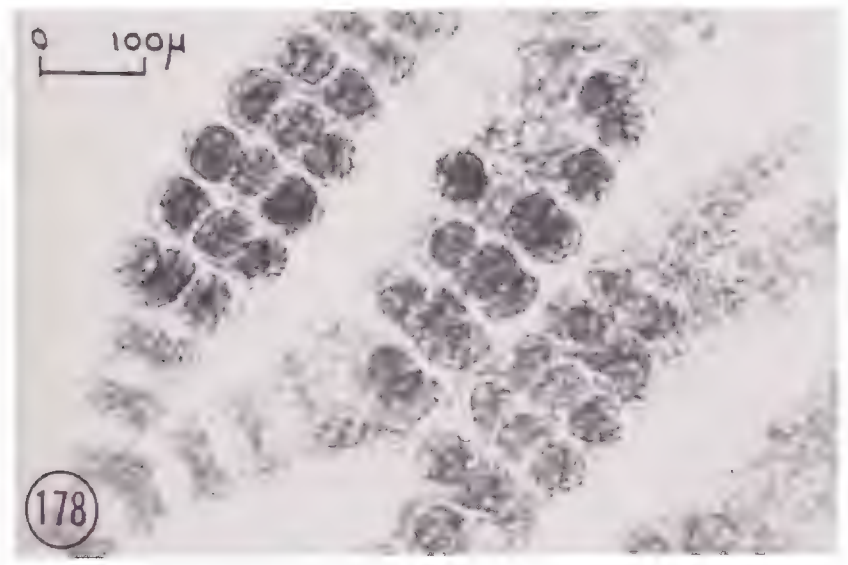

0 200μ
173


174
0 25μ

175
0 20μ

176
0 40μ

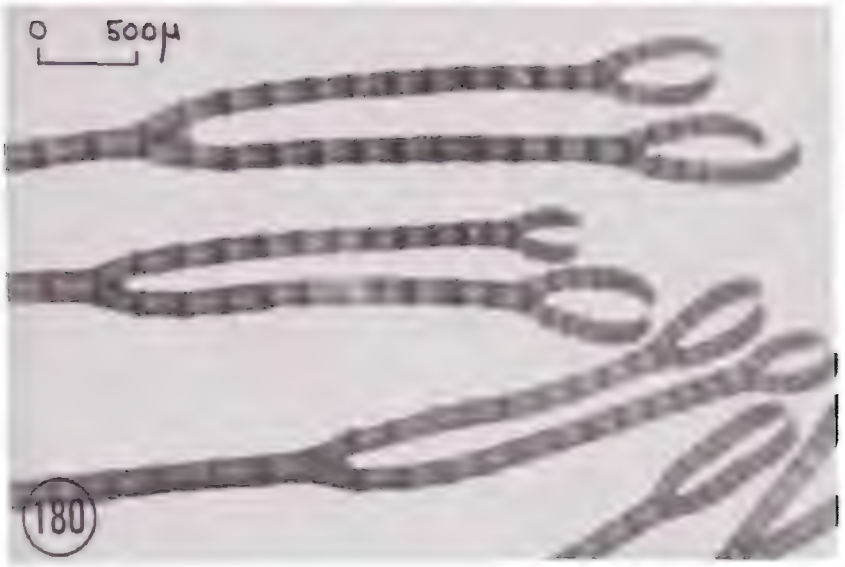
177
0 200μ

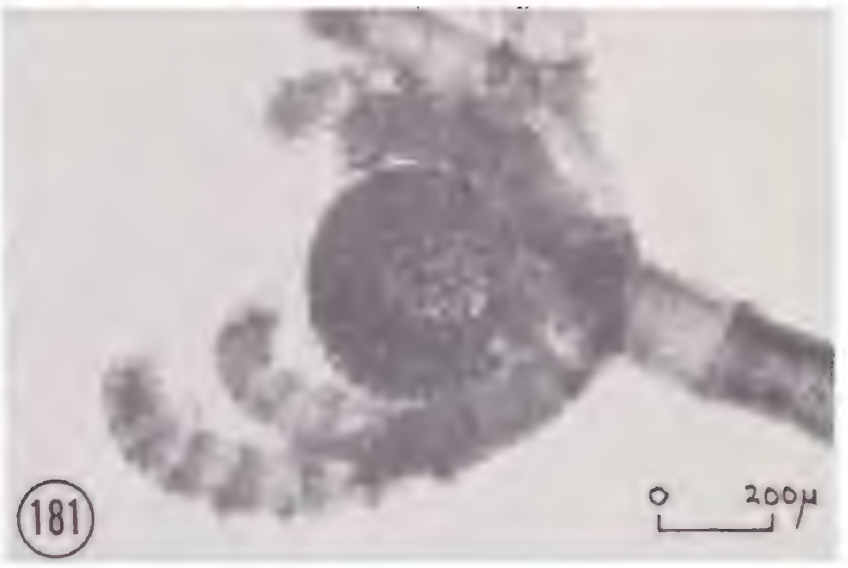

0 100μ
178

179

FIGURES 180–186

FIG. 180. *Centroceras clavulatum*; the upper portion of a filament showing the pattern of cortication and the pincer-like apices of the branches (preserved material).
FIG. 181. *Centroceras clavulatum*; a carposporophyte (preserved material).
FIG. 182. *Centroceras clavulatum*; tetrasporangia (preserved material).
FIG. 183. *Spyridia aculeata.*
FIG. 184. *Spyridia filamentosa.*
FIG. 185. *Spyridia aculeata*; the upper portion of a filament showing the pattern of cortication (preserved material).
FIG. 186. *Polysiphonia boldii.*

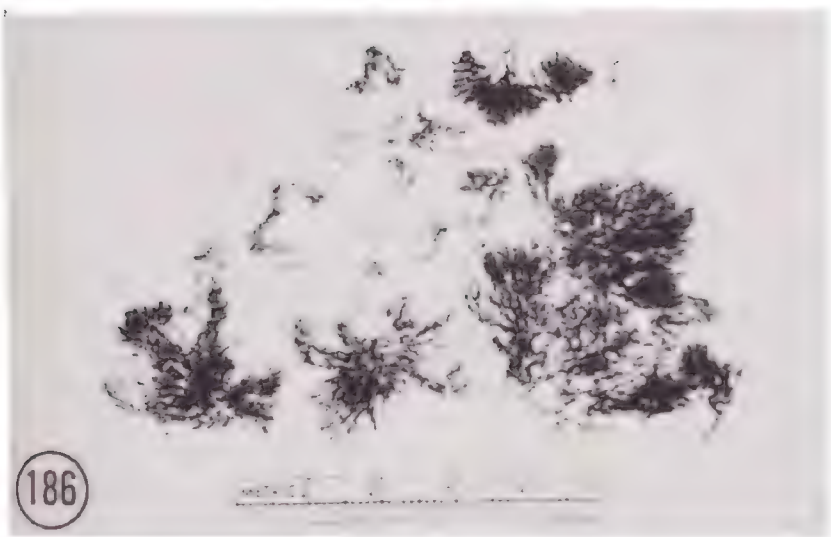

0 500μ
180


181
0 200μ

0 100μ
182

183

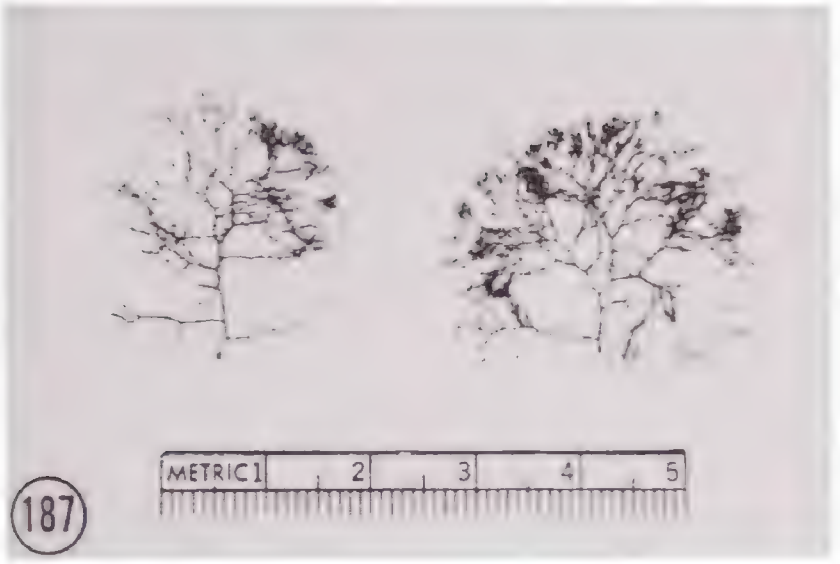
0 100μ
185


186

184

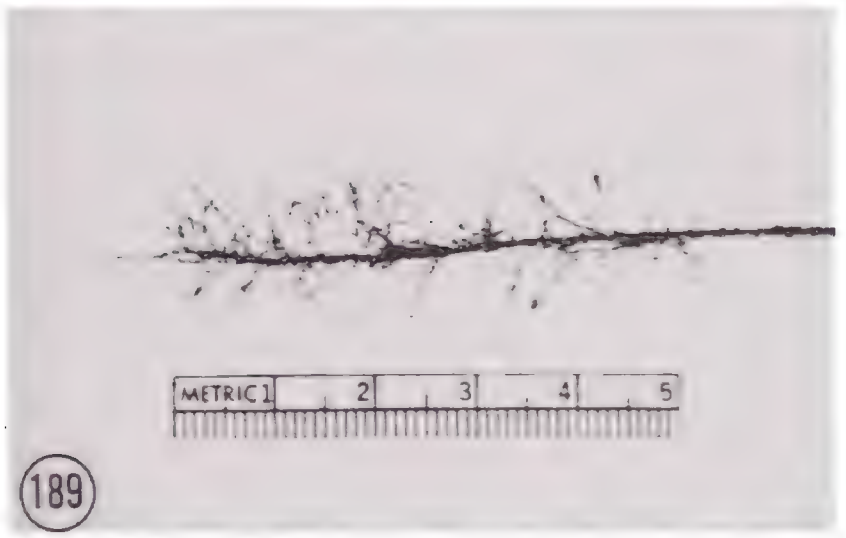
FIGURES 187–194

FIG 187. *Polysiphonia denudata.*
FIG. 188. *Polysiphonia echinata.*
FIG. 189. *Polysiphonia gorgoniae*; epiphytic on *Diplanthera wrightii.*
FIG. 190. *Polysiphonia havanensis.*
FIG. 191. *Polysiphonia subtilissima*
FIG. 192. *Polysiphonia tepida.*
FIG. 193. *Polysiphonia tepida*; the polysiphonous branches arise in the axils of the trichoblasts (preserved material).
FIG. 194. *Polysiphonia echinata*; the polysiphonous branches bear short, spine-like branches (preserved material).



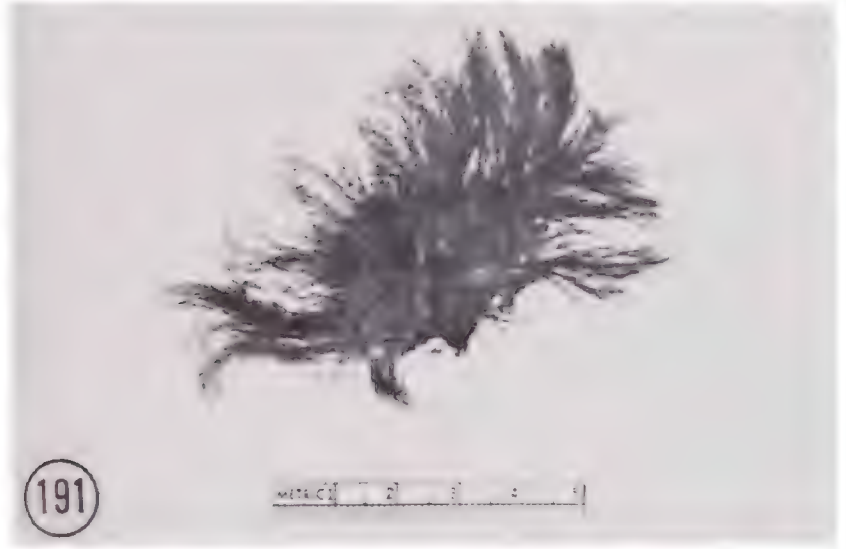
187

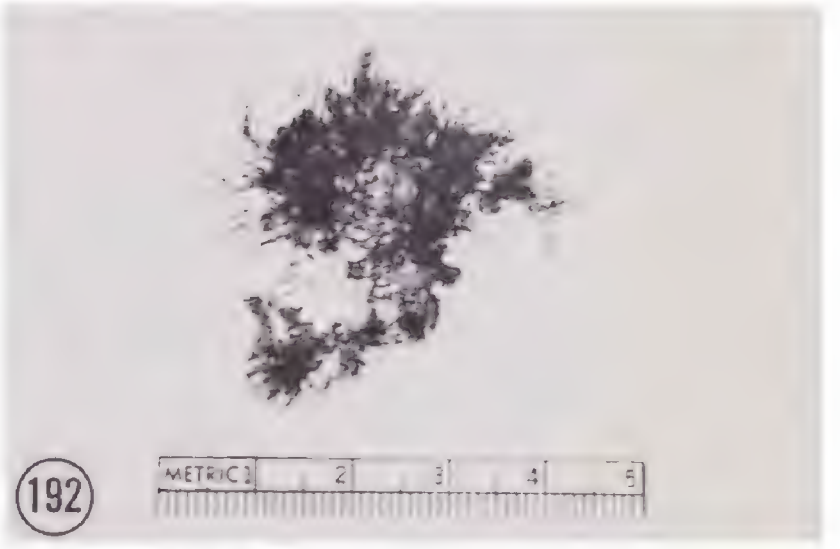
188



189

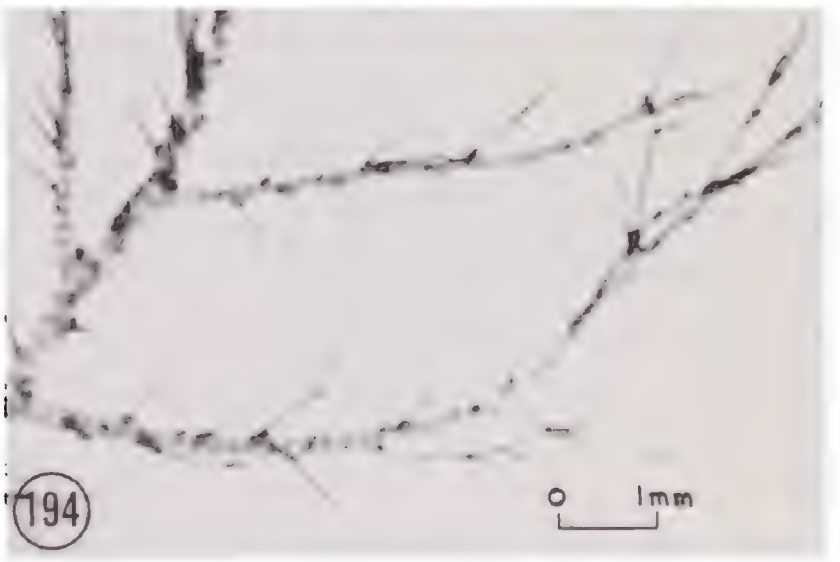
190


191



192

193



194

FIGURES 195–202

FIG. 195. *Polysiphonia tepida*; the eight pericentral cells and the single axial cell per segment, as determined by an HCl squash (living material from nature).

FIG. 196. *Polysiphonia denudata*; the antheridial branches occur singly with trichoblasts (preserved material).

FIG. 197. *Polysiphonia boldii*; the antheridial branches are formed in pairs, occasionally in threes (cultured material).

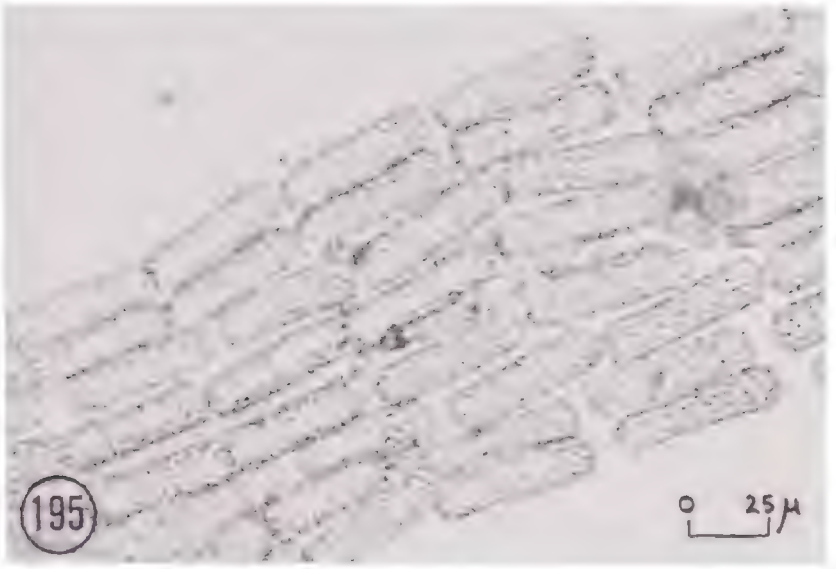
FIG. 198. *Polysiphonia boldii*; the carpogonium bears an elongated trichogyne on which adherent spermatia can be seen (cultured material).

FIG. 199. *Polysiphonia denudata*; cystocarps (preserved material).

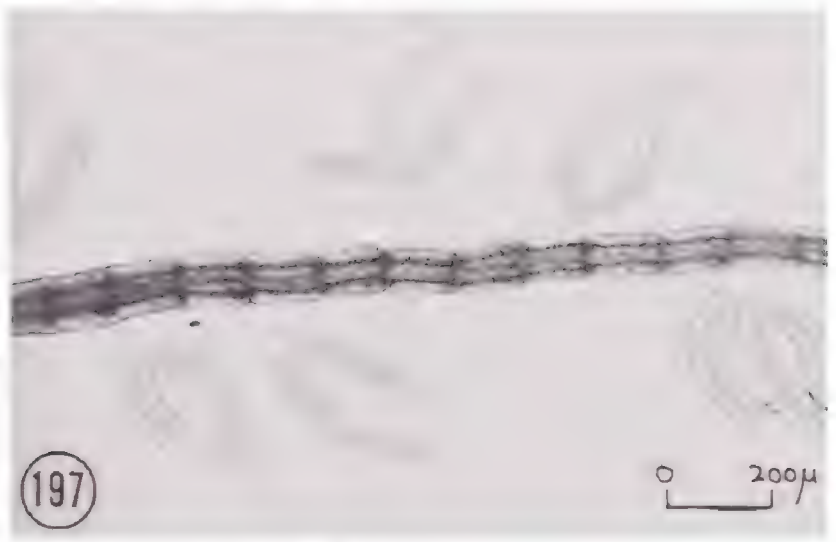
FIG. 200. *Polysiphonia denudata*; tetrasporangia (preserved material).

FIG. 201. *Bryocladia cuspidata*.

FIG. 202. *Bryocladia cuspidata*; the main axes bear short, stiff, lateral branchlets (preserved material).


195
0 25μ

196
0 100μ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0 200μ

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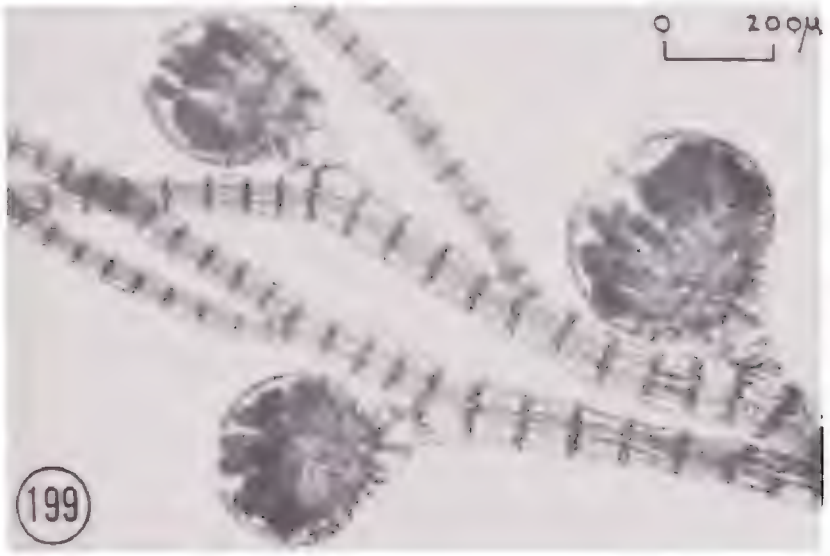
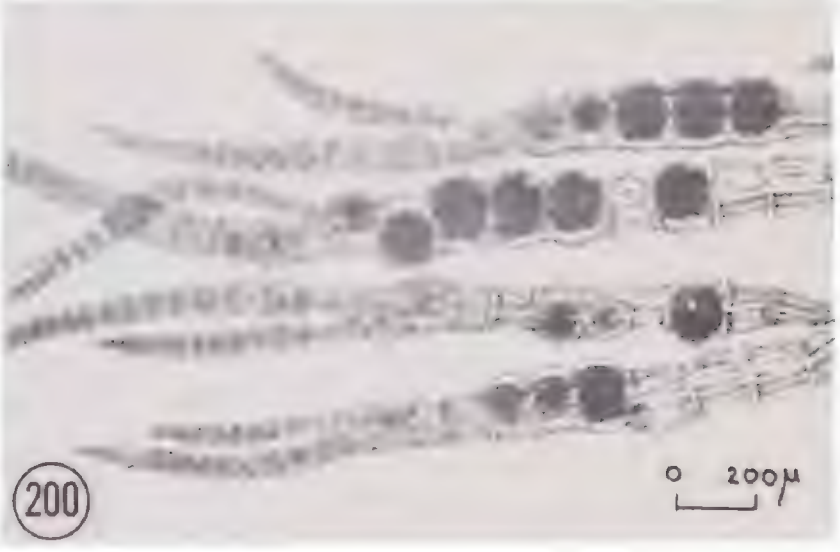
198


0 200μ
199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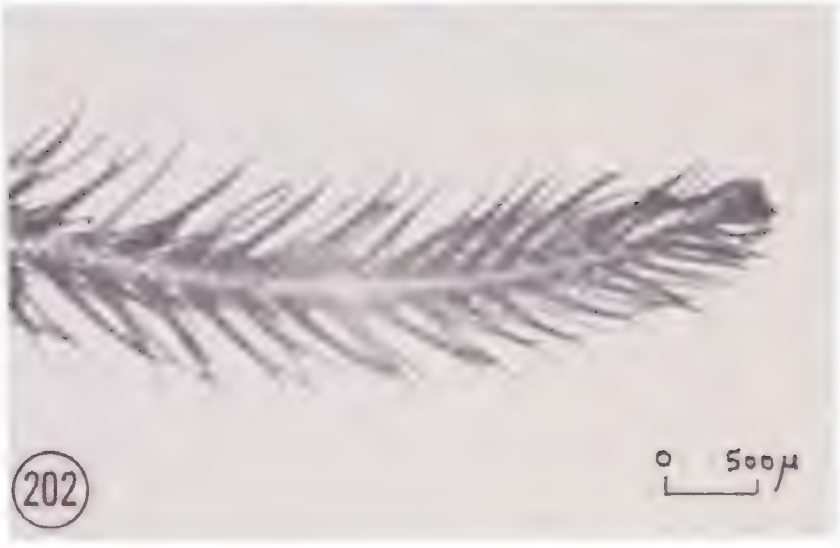
200

201


0 500μ
202

FIGURES 203–209

FIG. 203. *Bryocladia cuspidata*; antheridial branches (preserved material).
FIG. 204. *Bryocladia cuspidata*; a cystocarp (preserved material).
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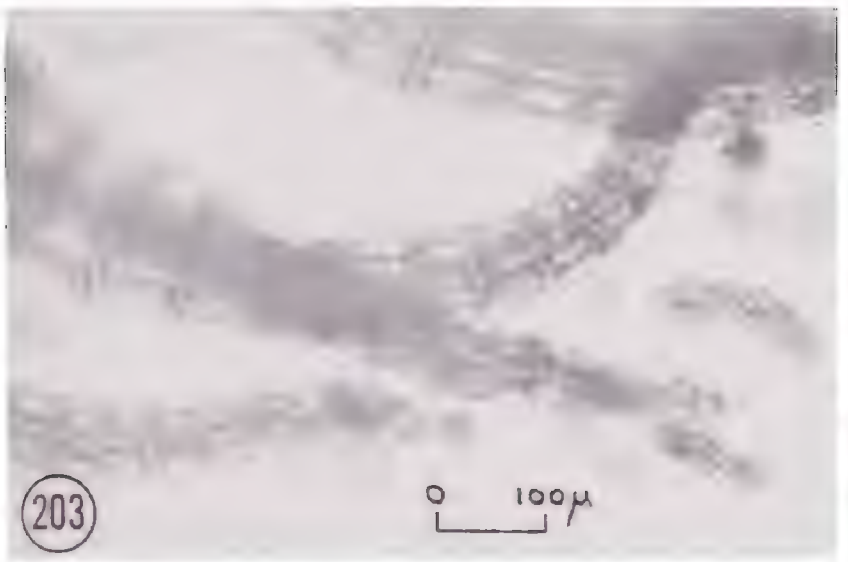
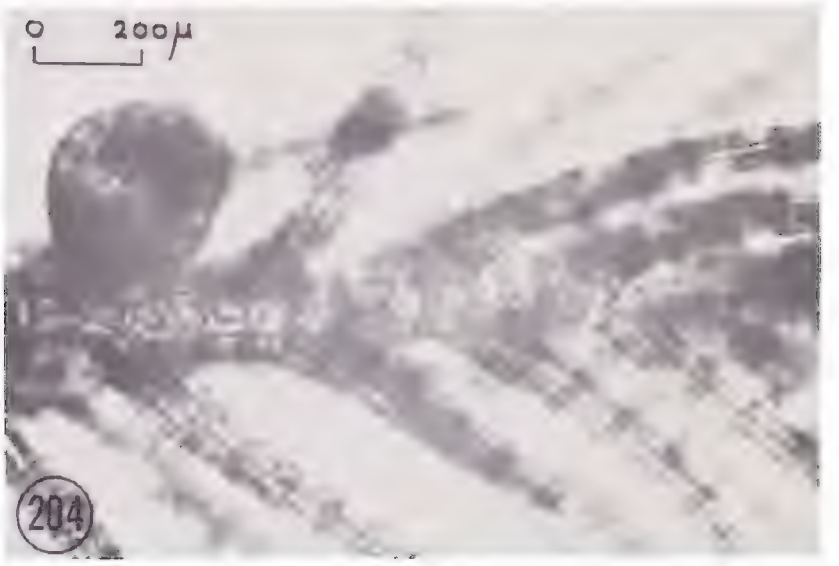
FIG. 209. *Digenia simplex*; a freezing-microtome transverse section of an axis showing the large-celled medulla surrounded by a small-celled cortex (preserved material).


203
0 100μ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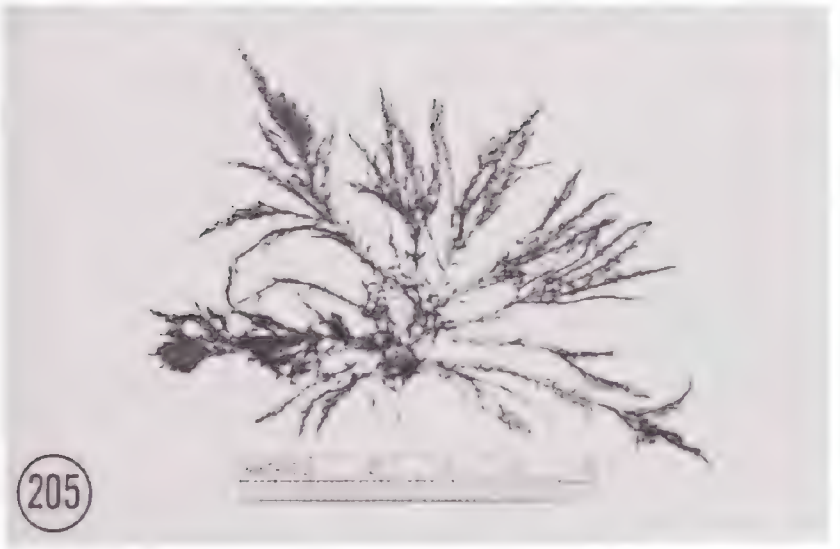
205

206
0 500μ

207

208
0 500μ

209
0 330μ

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FIG. 210. *Herposiphonia tenella*; detail of branching (preserved material).
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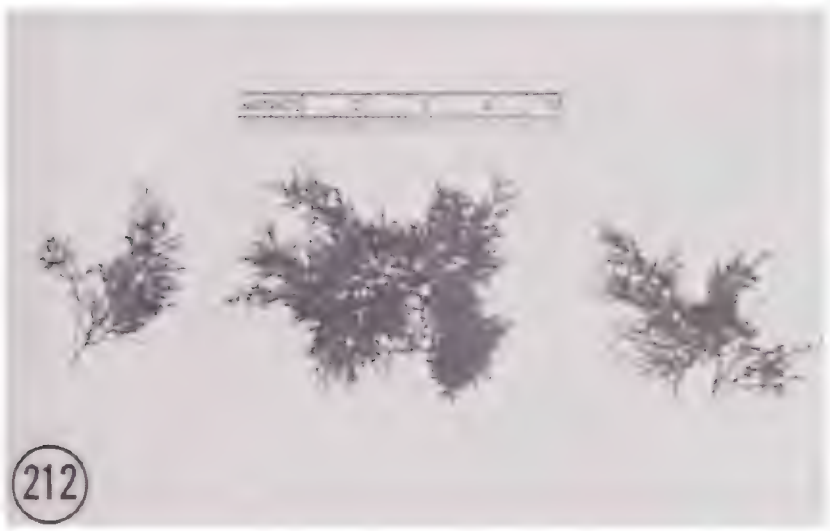
FIG. 215. *Chondria littoralis*; apex of an axis showing the acute tip and prominent apical cell (preserved material).

0 500μ
210


212

211

213
METRIC 1 2 3 4 5

0 200μ
214

215
0 100μ

FIGURES 216–221

FIG. 216. *Chondria dasyphylla*; a hand-cut transverse section of an axis showing a central axial cell surrounded by five pericentral cells to the center of the axis (preserved material).
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222

223

224
METRIC 1 2 3 4 5

225

# GLOSSARY

Algae: a diverse assemblage of lower plants from unrelated major groups.
Alpha ($\alpha$) spore: a pigmented spore of *Bangia* and *Porphyra*.
Alternate: placed on opposite sides of an axis at different levels.
Anastomose: to form an irregular network.
Antheridium: the sex organ producing male gametes.
Apical: at the apex or tip.

Benthic: attached.
Beta ($\beta$) spore: a colorless spore of *Bangia* and *Porphyra*.
Bilocular: with two locules or compartments.

Calcified: containing a deposit of calcium-magnesium carbonate.
Carpogonium: the female organ of the Florideophycidae.
Carpospore: the spore produced by the carposporophytic phase of the Florideophycidae.
Carposporophyte: a morphological phase which develops *in situ* on the female gametophyte following fertilization in the Florideophycidae.
Cartilaginous: hard and tough; with the texture of cartilage.
Coenocyte: a multinucleate thallus without partitioning cell walls.
Conceptacle: a superficial cavity opening to the surface within which reproductive organs are formed.
Cortex: the outermost cell layer(s) of an alga; generally composed of small, densely pigmented cells.
Cruciate: a method of division of a tetrasporangium by walls at right angles to each other; the four spores are visible in one plane.
Crustose: in the form of a crust.
Cyst: a spherical body produced in the gametangial rays of *Acetabularia* which releases gametes.
Cystocarp: a carposporphyte surrounded by a protective sterile envelope or pericarp.

Deciduous: falling off naturally.
Diaphragm: a cellular partition across a hollow thallus.
Dichotomous: a method of branching by forking into two equal parts.
Diffuse cell division: cell divisions which proceed throughout the thallus.
Dioecious: bearing male and female organs on separate plants.
Diplobiontic: a type of life-history with two free-living morphological phases.
Diploid: having two basic sets of chromosomes per cell.
Discoid: in the form of a disc.
Distromatic: composed of two cell layers.

Ecorticate: without corticating cells.
Epiphytic: a plant that grows upon another plant, using the host for attachment only (insofar as known).
Eulittoral: the zone on the shore that is alternately exposed to the air and submerged by the sea due to the tide.

Filament: a single row of cells, branched or unbranched.
Filiform: long, with a circular cross section.
Flagellum: a thread-like cytoplasmic outgrowth by means of which swarmers propel themselves.
Frond: a leaf-like or membranous thallus.

Gametangium: a cell or organ which produces gametes.
Gamete: a sex cell.

Gametophyte: a phase of the life-history which produces gametes.

Habit: the general form of a plant.
Habitat: the place of growth of a plant; its environment.
Haplobiont: an organism with one free-living morphological phase.
Haploid: having one basic set of chromosomes per cell.
Heteromorphic: having two different forms or appearances.

Intercalary cell division: cell division which takes place between the apex and base of the plant in localized regions.
Internode: the space between two nodes.
Isodiametric cell: a cell with sides of equal length.
Isomorphic: having two similar forms or appearances.

Lanceolate: lance-shaped; much longer than broad, broadest towards the base and tapering to the apex.
Life-history: the sequence of morphological and nuclear phases of an alga.
Littoral fringe: the zone on the shore that is not submerged but is kept moist by wash, splash and spray.
Locule: compartment.

Medulla: the cells to the center of the axis of an alga; generally large and colorless.
Meiosis: a type of nuclear division in which the chromosome number is halved and genetic segregation occurs.
Meristem: a region of active cell division.
Micron ($\mu$): one thousandth of a millimeter (mm), 1/25,000 of an inch.
Mitosis: a type of nuclear division in which there is no reduction in chromosome number.
Monoecious: bearing male and female organs on the same plant.
Monospore: a spore formed from the entire contents of a cell or monosporangium.
Monostromatic: composed of one cell layer.
Morphology: the study of form and reproduction.
Multiaxial: a type of thallus construction based on several axial filaments.

Node: the end walls of two adjacent cells in a uniseriate filament.

Oogonium: a single-celled female organ bearing one or more eggs.
Ostiole: a pore-like opening of a conceptacle or pericarp.

Parenchymatous: a type of thallus construction resulting from cell divisions in three planes at right angles.
Parietal: situated towards the cell wall, away from the center of the cell.
Pelagic: living unattached in the open sea.
Perennate: to live for more than one year.
Pericarp: a sterile protective envelope around a carposporophyte.
Pericentral cell: one of a ring of cells cut off from. and of equal length to, the central axial cell in the Florideophycidae.
Petiole: the stem-like, attaching base of a leaf.
Pinnate: having branches on opposite sides of an axis, as in a feather.
Pistillate: the female flower of a seed plant.
Plumose: feather-like.
Plurilocular organ: a type of reproductive organ found in the brown algae which is divided into several compartments (cells), each of which produces a single swarmer.
Pluriseriate: consisting of several rows of cells in cross section.
Polymorphic: of variable form or appearance.

Polysiphonous: composed of many cells ("siphons") as in *Polysiphonia* where a central axial cell is surrounded by several pericentral cells of equal length.
Pseudoparenchymatous: a type of thallus construction based on the elaboration of one or more filaments; the resulting compact thallus superficially resembles that produced by the parenchymatous type of construction.
Pyrenoid: a small body in the plastid which serves as a center of starch accumulation in green algae; its function is unknown in others.

Radial: developing uniformly around a central axis.
Reticulate: forming a network.
Rhizines: filaments composed of slender, thick-walled cells which penetrate the medulla in *Gelidium* and *Pterocladia.*
Rhizoids: slender filaments composed of one to several cells which serve as attachment organs.
Rhizome: a prostrate underground stem which produces roots as well as leaves.
Roots: downward-growing organs of vascular plants which serve for the absorption of water and mineral salts, as well as for attachment.

Sea grasses: monocotyledonous seed plants which superficially resemble grasses but do not belong to the Gramineae, the grass family.
Seaweeds: benthic marine algae.
Segments: the cells cut off from an apical cell.
Shoot: the stems and leaves of a seed plant.
Simple: unbranched.
Siphonous: coenocytic.
Sorus: a group or cluster of reproductive organs.
Spatulate: oblong with an attenuated base.
Spermatangium: antheridium.
Spore: a reproductive cell which is capable of producing a new individual without fusing with another cell.
Sporophyte: a phase in the life-history that produces spores.
Staminate: the male flower of a seed plant.
Stellate: star-shaped.
Stipe: the stem-like basal part of a thallus.
Sublittoral: the zone on the shore that is largely submerged by the sea and is only exposed by very low tides.
Swarmer: a motile reproductive cell.

Tendril: a curved and thickened branch apex which coils around objects with which it comes in contact.
Terete: cylindrical, and circular in cross section.
Tetrahedral: a method of division of a tetrasporangium by four walls formed in different planes and meeting at the center; three of the tetraspores, which are triangular in outline, are visible. in one plane.
Tetraspore: One of the four spores formed in a tetrasporangium.
Tetrasporophyte: a phase in the life-history of a red alga that produces tetraspores.
Thallus: The plant body of an alga (fungus or bryophyte).
Trichoblast: a simple or branched, colorless filament which arises from the apex of a plant in the Rhodomelaceae.
Trichogyne: the slender prolongation of a carpogonium for the reception of the spermatia.
Trichothallic: a type of intercalary cell division where the divisions are restricted to the bases of hairs.
Truncate: appearing as if cut off at the end.

Uniaxial: a type of thallus construction based on a single axial filament.

Unilateral: borne on one side.
Unilocular: possessing one locule or compartment.
Unilocular organ: a type of reproductive organ found in the brown algae which produces several swarmers in the single cavity of the organ.
Uniseriate: consisting of a single row of cells.
Vegetative: not reproductive.
Vesicular: bladder-like.
Zonate: a method of division of a tetrasporangium by three walls in the same plane; the four tetraspores lie in a single row.
Zoospore: an asexual swarmer.
Zygote: the cell formed by the fusion of male and female gametes.

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